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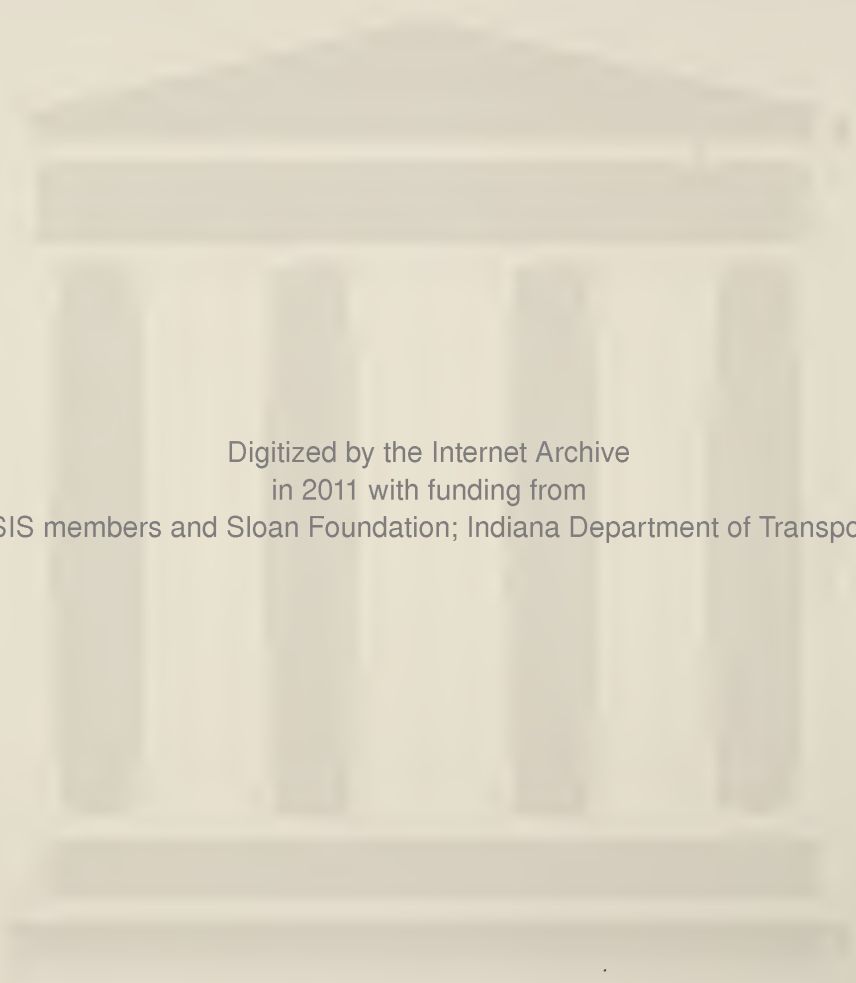
JOINT HIGHWAY
RESEARCH PROJECT
JHRP 88-9

ENGINEERING SOILS MAP OF
DECATUR COUNTY, INDIANA
FINAL REPORT

Timothy H. DeWitt



PURDUE UNIVERSITY



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Final Report

ENGINEERING SOILS MAP OF DECATUR COUNTY, INDIANA

TO: H. L. Michael, Director May 10, 1988
Joint Highway Research Project
Project: C-36-51B

FROM: Robert D. Miles, Research Engineer
Joint Highway Research Project File: 1-5-2-81

The attached report entitled "Engineering Soils Map of Decatur County, Indiana," completes a portion of the long term project concerned with the development of county engineering soils maps of the 92 counties in the State of Indiana. This is the 81st report of the series. The report was prepared by Timothy H. DeWitt, Research Assistant, Joint Highway Research Project.

The soils mapping of Decatur County was done primarily by the analysis of landforms on stereoscopic aerial photographs. Some test data from soil borings was obtained from IDOH. Generalized soil profiles for the landforms mapped are presented on the engineering soil map. A print of the engineering soils map of Decatur County is included at the end of the report.

Respectfully submitted,

Robert D. Miles

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Final Report
ENGINEERING SOILS MAP OF DECATUR COUNTY, INDIANA

by

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Research Assistant

Joint Highway Research Project

Project No.: C-36-51-B

File No.: 1-5-2-81

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ENGINEERING SOILS MAP
OF
DECATUR COUNTY, INDIANA

INTRODUCTION

The engineering soils map of Decatur County was completed using primarily aerial photographic interpretation techniques. Stereoscopic investigations of the photographs by proven observational methods were used for delineation of landform-parent material types [1]. The aerial photographs used in this project were taken for the U.S. Department of Agriculture in August, 1939. These photos were purchased from the U.S.D.A. and were printed at a scale of 1:20,000 (3 inches = 1 mile). The engineering soils map attached was prepared at a scale ratio of 1:63,360 (1 inch = 1 mile).

The soil boundaries were cross-referenced with the Agricultural Soil Survey of Decatur County, Indiana [2]. After mapping of the photos was completed, several trips to the county were made to help verify boundary and parent material interpretation. The map includes landform-parent material associations and surface soil textural symbols. All symbols on the map are standardized symbols developed by the staff of the Airphoto Interpretation Laboratory, School of Civil Engineering, Purdue University, for mapping of engineering soils. Shallow soil profiles shown on the attached map represent the soil horizons on the different parent material types. The profiles were developed

using data collected from the Decatur County Soil Survey, field sampling, field investigations, borehole records, and agricultural soil characterization data. The text of this report contains a general description of the area, a description of the soil and parent material types, and a discussion of possible engineering problems associated with the soil and bedrock of the county.

DESCRIPTION OF THE AREA

GENERAL

Decatur County is located in southeastern Indiana, 50 miles southeast of Indianapolis. Decatur County is bounded by Rush County on the north, Franklin County on the east, Jennings and Ripley Counties on the south, and Bartholomew and Shelby Counties on the west (see Figure 1). Decatur County is very odd shaped, with corners missing on the southeast and northwest sections. The county has dimensions of 5.5 to 21 miles in the east-west direction and 13 to 22 miles in the north-south direction. The maximum east-west dimension is in the middle section of the county and the maximum north-south dimension is on the western side. Decatur County covers approximately 370 square miles or 236,800 acres. Greensburg, the largest city and county seat, is located in the northcentral portion of the county.

Decatur County was founded in 1822. The land was ceded by the 1819 Treaty of St. Marys from the Delaware Indians. The population of Decatur County in 1980 was 23,841, with a growth of

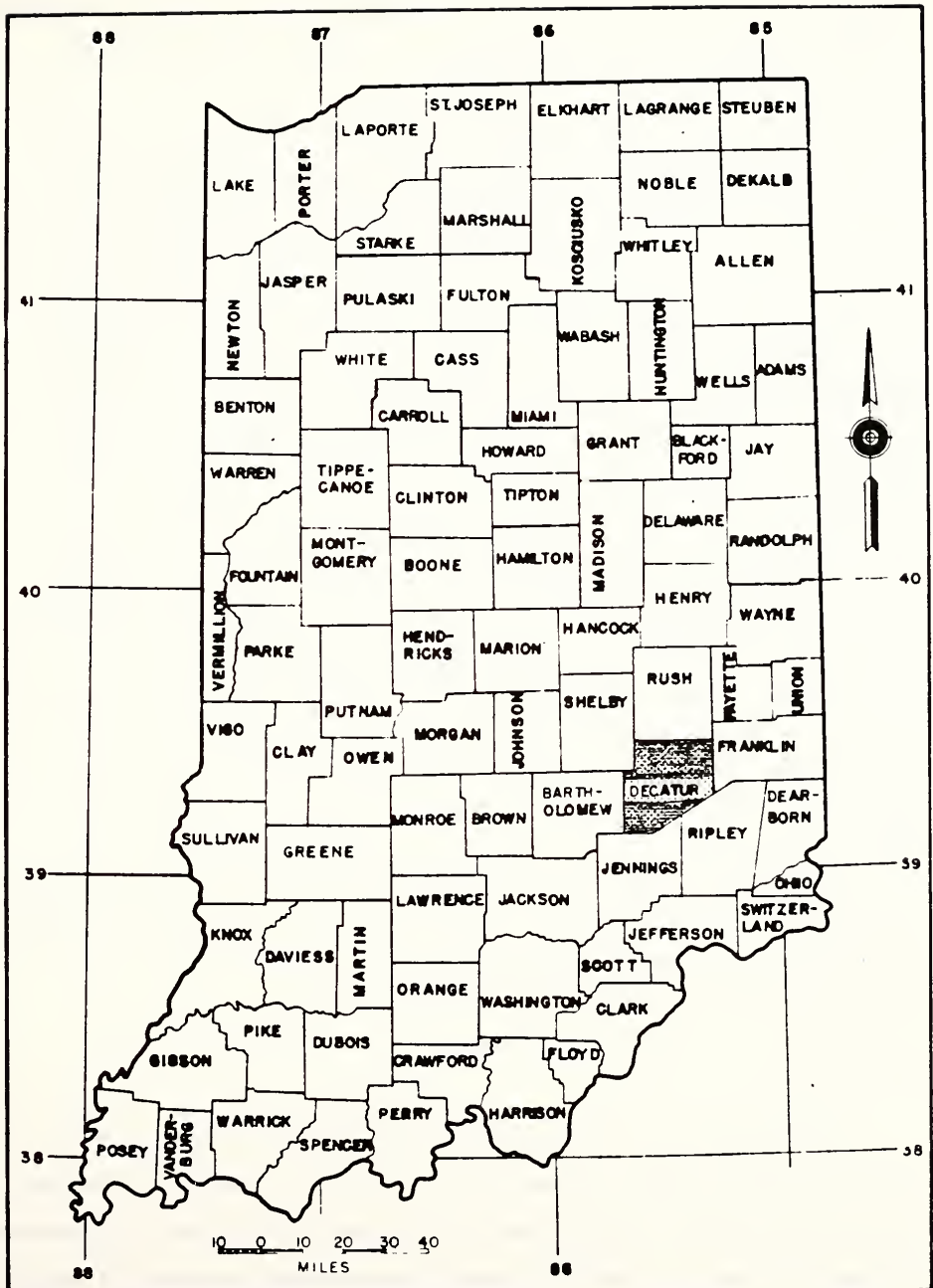


Figure 1. Location Map of Decatur County.

4.85% since 1970. Table 1 gives a population summary of Decatur County.

Table 1. Population Summary of Decatur County (3).

City	Population		Population change	
	1980 Census	1970 Census	Pop. Difference	Pct. Change
Greensburg	9,254	8,620	634	7.35%
Milford	177	187	-10	-5.35%
Millhousen	214	252	-38	-15.08%
New Point	296	381	-85	-22.31%
St. Paul & She	976	785	191	24.33%
Westport	1,450	1,170	280	23.95%
Totals				
Cities & Towns	12,367	11,395	972	8.53%
Rural Areas	11,474	11,343	131	1.15%
County Total	23,841	22,738	1103	4.85%

Farming provides the major income in Decatur County. Approximately 96 percent of the available land is used for agriculture [2]. Of this land, about 72 percent is used for cropland, with corn being the primary crop.

There are other natural resources in Decatur County besides farmland. These natural resources include mineable limestone, sand and gravel aggregate, and natural gas.

CLIMATE

The climate of Decatur County is characterized by four distinct seasons. The summers are hot with high humidity and the winters are cold. Precipitation is generally evenly distributed among the months of the year. The county experiences frequent

temperature and humidity changes due the clash of warm tropical air from the south with cold polar air from the north.

Table 2 gives temperature and precipitation statistical data for Decatur County as recorded at Greensburg, Indiana [2]. These data were recorded between 1951 and 1976 at the Greensburg weather station.

The average daily temperature in Decatur County is 52 degrees F. July is generally the warmest month of the year in the county with an average daily temperature of 73.3 degrees F. On the average, the maximum temperature will exceed 90 degrees F approximately thirty-four days out of the year. The coldest month of the year is January. During January, the daily average temperature reaches 28.6 degrees F. The temperature will not reach 32 degrees F approximately twenty-two days each year.

The average yearly precipitation in Decatur County is 39.88 inches. This precipitation comes in the form of rain, snow, and sleet throughout the year. The month of May generally receives the most precipitation with a total average of 4.62 inches for the month. February usually receives the least precipitation with only 2.60 inches. During the winter months of the year, Decatur County expects to receive on the average approximately 16.6 inches of snow accumulation.

Winds in Decatur County blow most frequently from the southwest. During one or two of the winter months, the wind blows from the northwest. Thunderstorms occur on about eight days of

Table 2. Climatological Summary for Decatur County (2).

Month	Temperature					Precipitation				
	Mean daily max. min.			2 years in 10 will have		Mean			Mean snowfall	
				Max. temp. higher than	Min. temp. lower than					
	°F	°F	°F	°F	°F	In.	In.	In.	In.	In.
January	38.1	19.1	28.6	66	-17	2.61	1.23	3.74	4.4	4.4
February	42.3	22.3	32.3	67	-11	2.60	1.04	3.84	3.3	3.3
March	51.4	29.9	40.7	78	5	3.67	1.70	5.27	3.6	3.6
April	64.6	40.4	52.5	84	19	4.14	2.18	5.74	0.2	0.2
May	73.9	49.2	61.6	90	26	4.62	2.42	6.41	0.0	0.0
June	82.4	58.1	70.3	95	39	3.99	2.41	5.40	0.0	0.0
July	85.6	61.1	73.3	96	44	4.23	2.29	5.82	0.0	0.0
August	84.4	58.7	71.6	96	43	2.86	1.28	4.14	0.0	0.0
September	78.6	52.3	65.5	95	31	2.86	1.20	4.19	0.0	0.0
October	67.8	41.0	54.4	88	18	2.35	1.15	3.32	0.0	0.0
November	52.1	31.3	41.7	77	6	3.05	1.68	4.16	2.0	2.0
December	40.9	23.0	32.0	67	-10	2.90	1.04	4.37	3.1	3.1
Yearly Average:	63.5	40.5	52.0	Yearly Totals:						
						39.88	34.04	45.82	16.6	16.6

the year, usually in the spring and early summer [4].

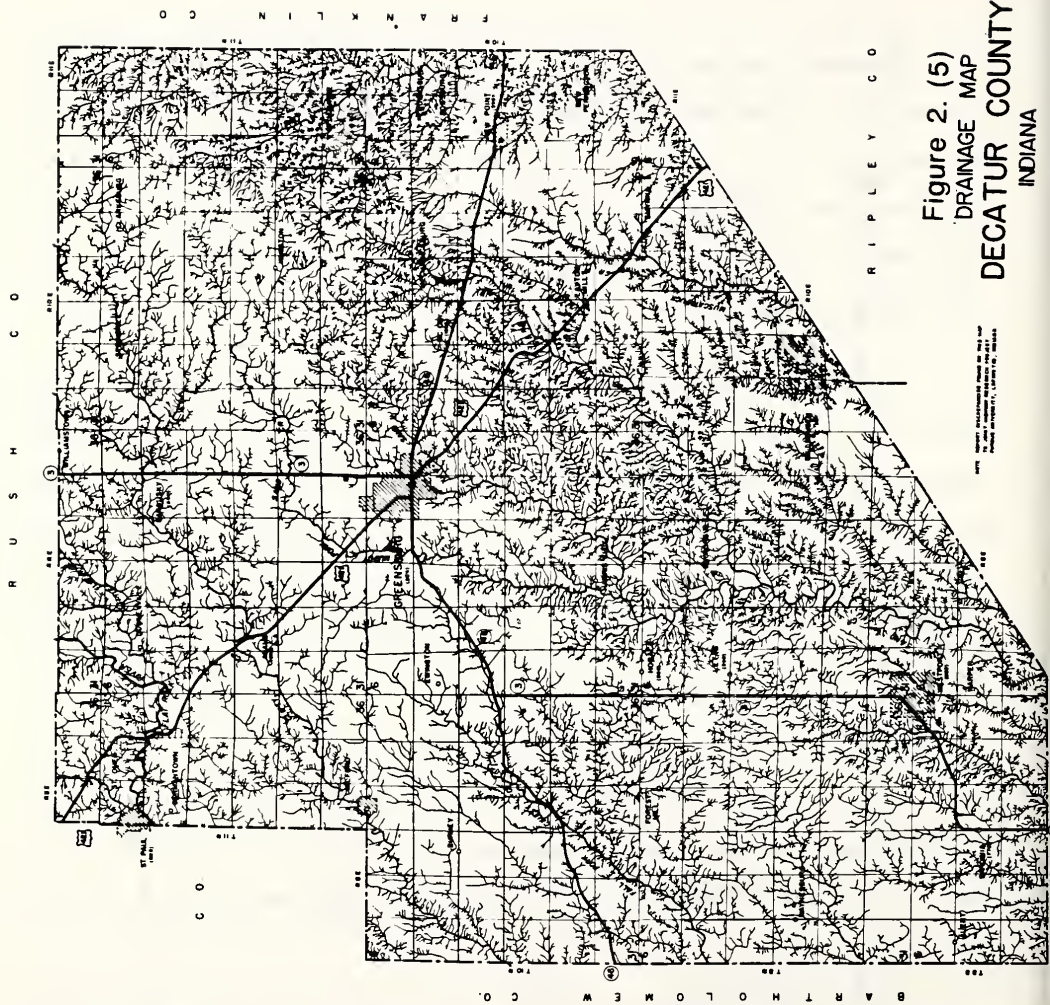
DRAINAGE FEATURES

Figure 2 is the "Drainage Map of Decatur County, Indiana" prepared in 1948 by the Joint Highway Research Project at Purdue University [5]. Decatur County is drained by portions of three drainage watersheds of Indiana. These include the Upper East Fork White River watershed, the Whitewater River watershed, and the Minor Ohio watershed.

The Upper East Fork White River watershed drains everything west of a line from approximately Clarksburg in northeastern Decatur County to Smyrna in southeastern Decatur County. This area is roughly 80 percent of the county. The major rivers and creeks of the drainage basin includes: Flatrock River, Clifty Creek, Fall Fork Clifty Creek, Sand Creek, and North Fork Muscatatuck River.

Flatrock River drains the northwest corner of the county. It is formed by the joining of Little Flatrock River with Big Flatrock River approximately three miles east of St. Paul. Flatrock River leaves the county at St. Paul. Silurian age bedrock can be seen outcropping along the river's banks.

Clifty Creek and its tributaries drain the central-northern and the central-western sections of the county. Clifty Creek is formed near Sandusky when Middle Branch Clifty Creek from Rush County joins with North Clifty Creek. South Branch Clifty Creek



enters Middle Branch Clifty Creek about one mile east of Sandusky. Clifty Creek flows southwesterly from Sandusky and leaves Decatur County three miles west of Burney. The western part of the county just south of Clifty Creek is drained by Fall Fork Clifty Creek. Fall Fork Clifty Creek parallels Clifty Creek and leaves the county two and one half miles south of S.R. 46. It joins Clifty Creek inside of Bartholomew County.

The central and southwestern sections of the county are drained by Sand Creek and its tributaries. Sand Creek's tributaries include: Middle Fork Sand Creek, Cobbs Fork Sand Creek, Panther Creek, Millstone Creek, Rock Creek, Turnover Creek, Popular Creek, and Bear Creek [6].

One small section in the south-central part of the county west of Smyrna is drained by North Fork Muscatatuck River and its tributary Squaw Creek. They leave Decatur County just east of Millhousen.

The Whitewater watershed drains the northeastern and central-eastern sections of the county, east of the Upper East Fork basin and north of New Point. The area drained is approximately 15 percent of the county. Salt Creek and its tributaries drain in a southeasterly direction into Franklin County. The small southeastern corner of the county east of Smyrna and south of New Point is part of the Minor Ohio watershed. Laughrey Creek drains this section southeasterly into Ripley County. The area drained is approximately 5 percent of the area of the county.

There are several characteristic drainage patterns identified in Decatur County. Two-thirds of the county is covered by Wisconsinan till plain having a dendritic to subdendritic pattern with local mottled tones. The Illinoian till plain is characterized by a very highly dissected dendritic pattern. On stream terraces the streams are largely absent due to the highly porous nature of underlying granular materials. Another striking drainage feature is an abandoned glacial sluiceway located approximately two miles southeast of St. Paul. Moraines in the county have also influenced the drainage patterns of some streams of the county. Morainic control is seen by local watershed divides, increased drainage density, and deflection of streams occur in these areas [5]. In Decatur County, Sand and Clifty Creeks flow over these ridge moraine areas. Due to increased meltwaters during glacial retreat, some of the streams in the Wisconsinian areas are underfit to the broad valleys that they occupy.

Generally, the streams in Decatur County have narrow flood-plain width of less than 170 to 240 feet. But in sections of Sand Creek, Clifty Creek, and the Flatrock River, the width is considerably wider, up to almost one-quarter of a mile. Bedrock may be found outcropping or within a couple of feet of the surface in sections of all of the first and second order streams in the county. Thus, it is no surprise that the course of the streams are bedrock controlled. Along sections of Sand Creek in the southern part of the county, subterranean drainage occurs [5]. On

the airphotos, numerous sinkholes were noted.

There are no natural lakes in Decatur County. However, scattered ponds and several artificial lakes do exist throughout the county (see engineering soils map for locations) [5].

Table 3 has drainage densities for selected streams in the county. The table includes the area drained in square miles and also the number of streams per square mile [7].

Appendix A contains statistical streamflow data for the Whitewater River (at Brookville, Franklin County); Sand Creek (near Brewersville, Jennings County); Clifty Creek (at Hartsville, Decatur County), and Flatrock River (at St. Paul, Shelby County). The information supplied includes lowest and highest mean discharge, average daily discharge, flow duration, and statistics on normal and log monthly, log annual means, and peak annual discharge [8].

Low flow characteristics for streams, which drain Decatur County, are given in Appendix B. The streams included are: Flatrock River (at St. Paul, Shelby County); Clifty Creek (at Sandusky, Decatur County); Clifty Creek (at Hartsville, Decatur County); Sand Creek (near Greensburg, Decatur County); and Sand Creek (near Brewersville, Jennings County). Selected discharge characteristics are given for all five streams. In addition, magnitude and frequency of annual and summer low flow data are presented for three of the five stream sites [9]. This type of data is useful for evaluation of water resource management.

Table 3. Drainage Densities for Selected Streams in Decatur County (7).

Stream And Location	Quad.	Sec.	Twn.	Rng.	Drainage Area (mi ²)	Drainage Density (streams/mi ²)
Clifty Creek including Pond Branch	Forest Hill	34	11N	8E	75.3	4.6
Cobbs Fork at Mouth	Westport	16	9N	9E	29.7	7.6
Little Flat Rock River at Mouth	Adams	7	11N	9E	63.3	3.6
Middle Branch Clifty Creek at Mouth	Milroy	12	11N	9E	25.6	3.2
Middle Fork of Fall Fork Clifty Creek at State Road 46	Hartsville	31	10N	8E	9.5	3.9
Penther Creek at Mouth	Westport	5	8N	9E	8.8	8.7
Sand Creek above Cobbs Fork	Westport	16	9N	9E	60.5	5.9
Turnover Creek at Mouth	Westport	15	8N	8E	4.1	6.2
South Branch Clifty Creek at Mouth	Milroy	7	11N	10E	6.2	4.9
Vyaloosing Creek at S.R. 3	Westport	1	8N	8E	10.5	4.9

PHYSIOGRAPHY

Decatur County contains two subsections of the Central Lowlands Province of North America. These two from east to west are the Dearborn Upland and the Muscatatuck Regional Slope [10]. The Dearborn Upland is a dissected low plateau consisting of Late Ordovician flat-lying limestones and shales outcropping along the crest of the Cincinnati Arch. These rocks are overlain by generally less than 50 feet of glacial and unconsolidated deposits in Decatur County. The western boundary of the Dearborn Upland is the drainage divide between the southeasterly flowing streams and the southwesterly flowing streams of the county. Generally, the Dearborn Upland includes the Whitewater watershed and the Minor Ohio watershed sections. The name usually given to this drainage divide is the Laughrey Escarpment for it provides a low dividing ridge [12].

West of the Dearborn Upland is the Muscatatuck Regional Slope. The Muscatatuck Regional Slope is interpreted to be a plain containing westwardly-dipping Devonian and Silurian Age carbonate rocks. This plain slopes westward at approximately 15 feet per mile. The carbonate rocks are covered with as much as 100 feet of Illinoian and Wisconsinian glacial drift. The region is still in a youthful stage of landform development [10]. Figure 3 is a map of the physiographic units of Indiana [10]. The generalized bedrock geology of Indiana is depicted in Figure 4 [11].

TOPOGRAPHY

The topography of Decatur County can be characterized as

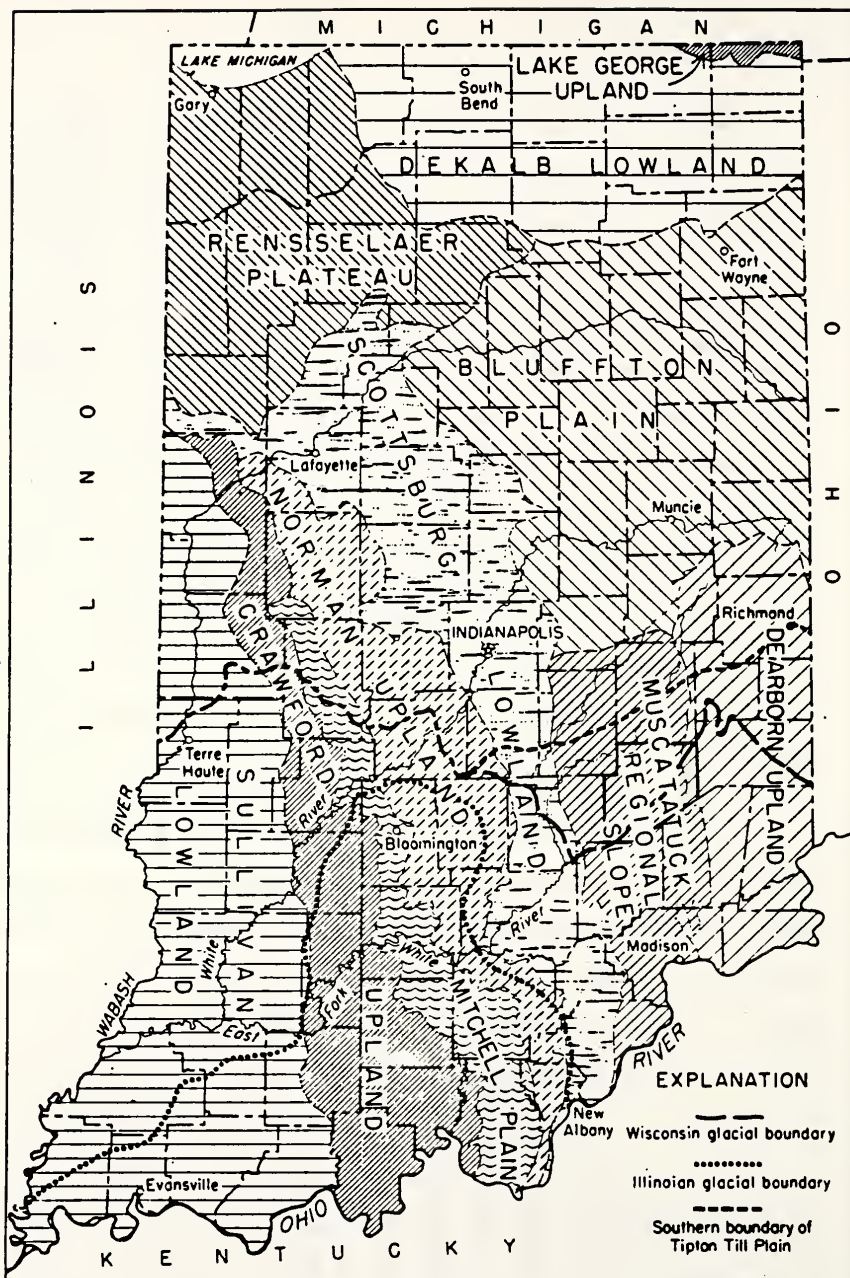


Figure 3. Map of Indiana Showing Physiographic Units and Glacial Boundaries (10).

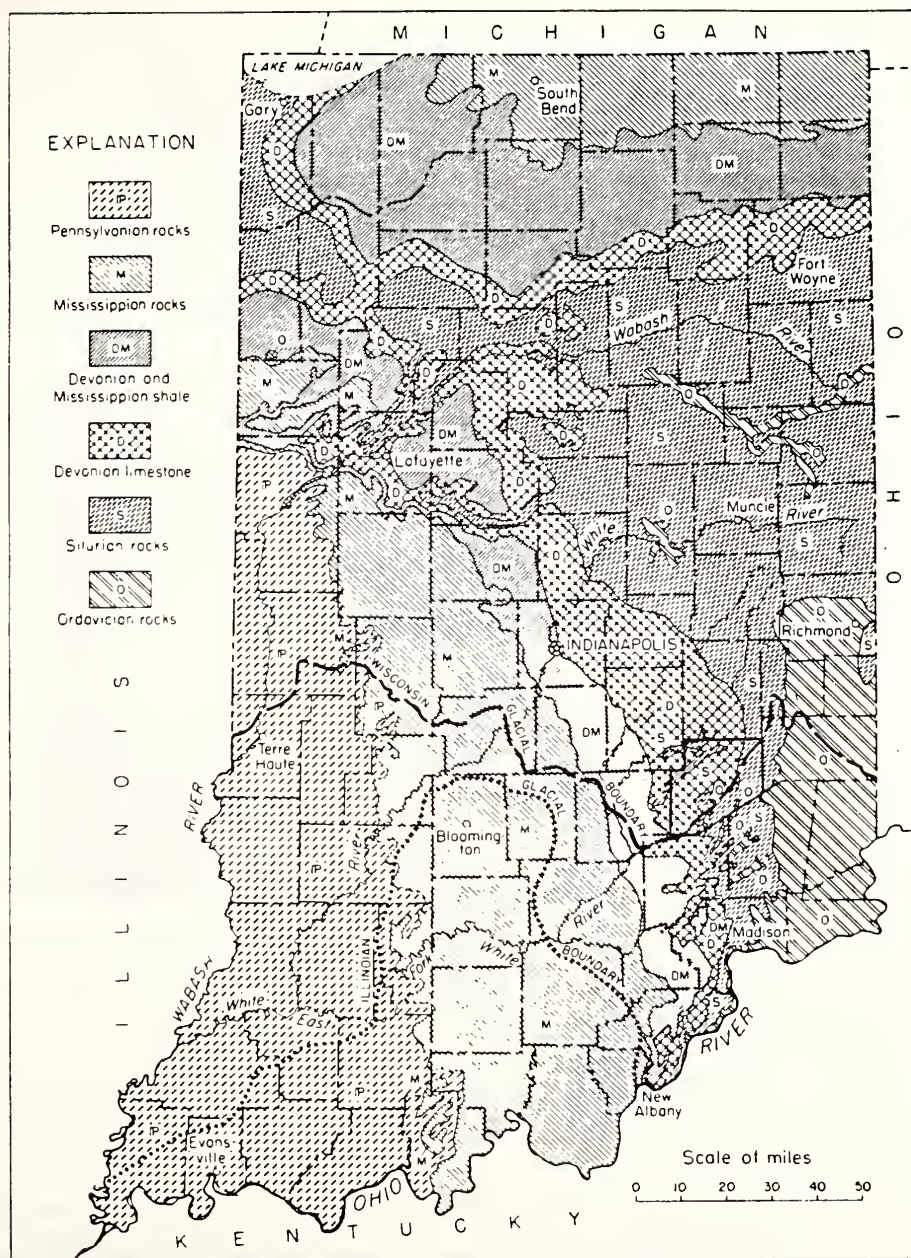


Figure 4. Generalized bedrock geology map of Indiana (after Patton, 1955, p. 12). (11)

ranging from flat to very hilly. Elevations vary from 1093 feet between Kingston and St. Maurice in the northeastern part of the county to 643 feet south of Westport in the southwestern part of the county. The maximum local relief is approximately 140 feet [6]. Figure 5 is a general topographic map for Decatur county based on 100 foot contour intervals [13].

The section of the county east of the Wisconsin-Illinoian glacial boundary is a topography characterized as nearly flat. This area is the Illinoian ground moraine. Near the streams and gullies the ground moraine has been severely eroded. Along Sand Creek, where the ground moraine is thin and the limestone is close to the surface, numerous sinkholes exist.

The section of the county west of the Wisconsin-Illinoian glacial boundary is a topography shaped mainly by Wisconsin-age glaciation. The variety of materials and structures left by the glaciation has produced a topography which is gently undulating to rolling. Most of the materials left are categorized as glacial till. This undulating plain has local elevations differences between 5 to 25 feet where it is uncut by stream dissection. Stream entrenchment into the plain has produced stream valleys which are as much as 75 feet below the ground moraine surface.

The Wisconsin ridge moraine area exhibits a rolling topography, rising 20 to 30 feet above the undulating Wisconsin ground moraine and the nearly flat Illinoian ground moraine. A

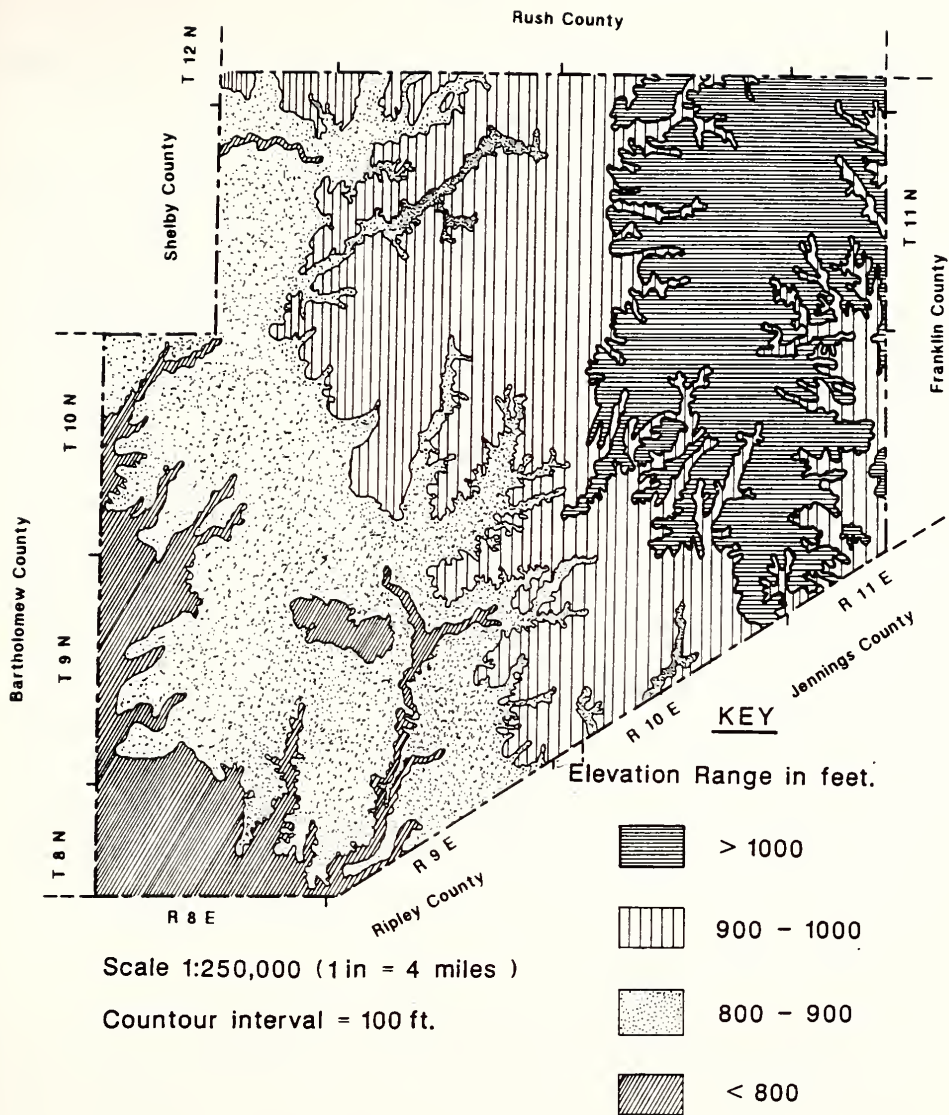


Figure 5. Topographic Map of Decatur County (13)

distinct topographic boundary is traced by the ridge moraine between the two glacial stages of the county.

The most prominent topographic features in Decatur County are the kames. The kames are glacio-fluvial deposits which rise 20-65 feet above the surrounding ground moraine. The largest of the kames is located one-half mile east of Adams. The Adams kame rises 65 feet above the plain and is between one-quarter and one-half mile in diameter. Kames are common around St. Omer and Adams.

Another interesting topographic feature of Decatur County is the Burney esker. An esker is a winding ridge of glacio-fluvial material. The Burney esker ranges between 10 to 25 feet in height and is about one mile in length. The ridge is single except in one section where it is a double set of parallel ridges. The Burney esker is not accompanied by an esker trough or a delta on its southern end, which is common with most observed eskers [6].

STRUCTURAL GEOLOGY

Structurally, Decatur County lies on the western limb of the Cincinnati Arch. The Cincinnati Arch is a large anticline of slightly dipping Pennsylvannian, Mississippian, Devonian, Silurian, and Ordovician Age rocks. Figure 6 is a map showing the structural geology of Indiana. The dip of the rock strata is in a west-southwestwardly direction of between 15-20 feet per mile. Figure 7 is a cross-section and block diagram of Decatur County

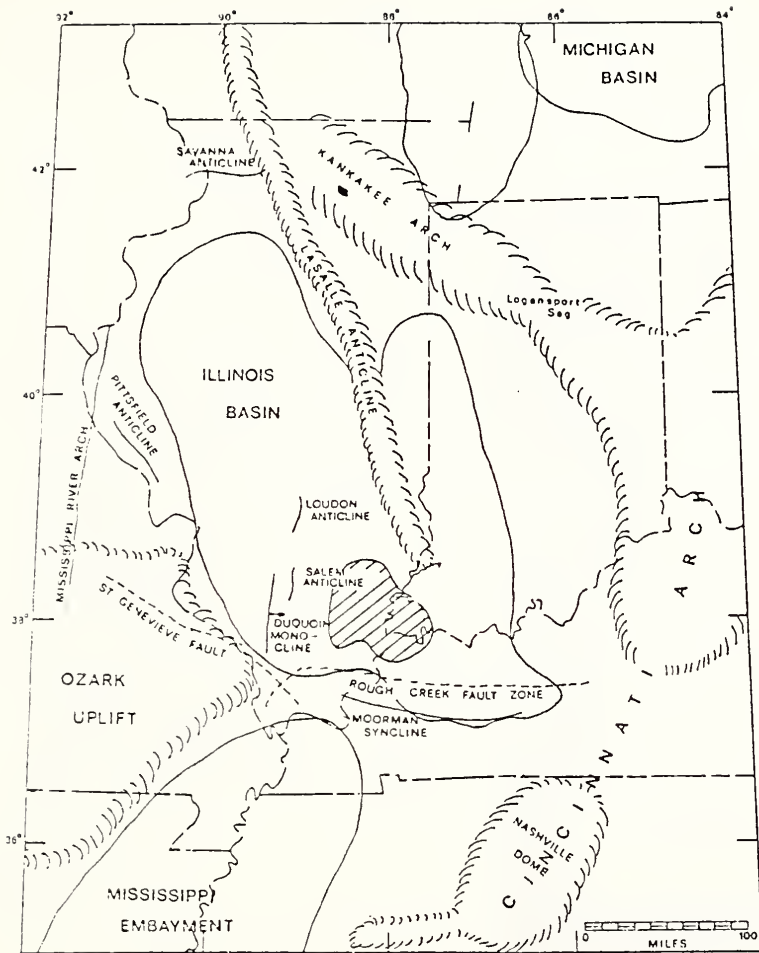


Figure 6. Structural Geology and Setting of Indiana

showing the relationship between the structural geology, the physiography, and the bedrock geology of the county [12].

BEDROCK GEOLOGY

Decatur County contains rock units from portions of three rock systems [14]. These are the Devonian, the Silurian, and the Ordovician. The bedrock units of these systems generally lie in north-south bands in the southern section of Indiana. Locally, within Decatur County, erosion of the preglacial valleys has led to an interfingering of the different rock systems. Erosion exposed the older underlying rocks.

The bedrock geology is represented in Figure 8 [15]. Table 4 is a stratigraphic column for Decatur County indicating bedrock units and glacial deposits which outcrop or cover the county [16]. The column is time dependent showing units from youngest to oldest in age. In addition, the column gives a range of anticipated thicknesses for each unit and also a description of that unit.

The Devonian system contains three units [17]. These are the North Vernon Limestone, the Jeffersonville Limestone, and the Geneva Dolomite. The units of the Devonian may be found in the preglacial valleys in the western part of the county. They outcrop in parts of the stream valleys in the same area. The youngest of the Devonian units is the North Vernon Limestone. In Decatur County, the North Vernon Limestone ranges in thickness

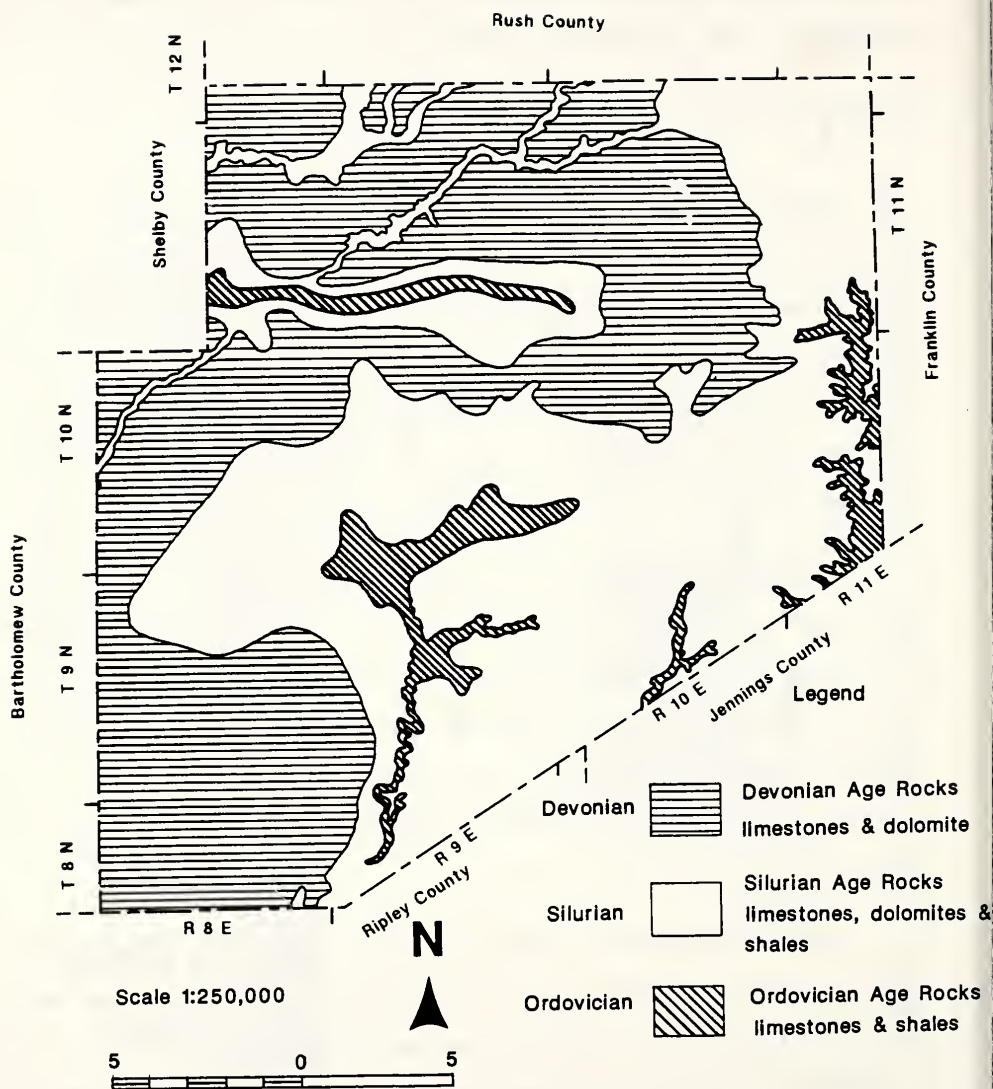


Figure 8. Bedrock Geology Map of Decatur County (15)

Table 4. Stratigraphic Column of Bedrock Formations in Decatur County (16)

ERATHEM	SYSTEM	SERIES OR STAGE	STRATIGRAPHIC UNIT	THICKNESS (FEET)	HYDRO- GEOLOGIC UNIT	UNIT CHARACTERISTICS
Cenozoic	Quaternary	Pleistocene	Wisconsinan deposits	0-100	Till	Unconsolidated till and minor segregation of coarse material; soils brownish-gray to reddish-brown; undulating surface, low relief.
			Illinoian deposits and older	0-141 0-67		Unconsolidated till, mostly clay; soils light-gray on flats to reddish-gray on slopes; flat uplands, deeply dissected by streams.
Paleozoic	Devonian	Erian	North Vernon Limestone ¹	0-20	Upper limestone and dolomite sequence	Limestone, dark-gray to blue-gray, fine to coarse-grained, hard and fossiliferous. Upper half, thick bedded; lower half, thin to medium bedded.
			Jeffersonville Limestone ¹	0-30		Limestone, gray to brown; greatly varying lithology from top to bottom with laminated breccia zone and coral zone; abundant calcite and pyrite recrystallization.
		Uisterian	Geneva Dolomite ¹	0-30		Dolomite, buff to chocolate-brown; fine-grained, soft, sugary texture; thin bedded at top and thick bedded at base; large recrystallized calcite common.
Paleozoic	Silurian	Niagaran	Louisville Limestone	0-30	Upper limestone and dolomite sequence	Dolomitic limestone, tan to brown, very fine grained, argillaceous; thick bedded; fossils distorted, commonly mottled and with chert zones.
			Waldron Shale	0-6	Shale	Shale, blue-gray and clayey; thin bedded; very fossiliferous and easily eroded.
			Laurel Member	0-80	Lower limestone and dolomite sequence	Dolomitic limestone, light-gray to tan, fine-grained and argillaceous; thick bedded with abundant chert.
		Salamonia ¹ Dolomite	Osgood ¹ Member			Dolomite or limestone, tan to tan-gray, highly argillaceous; shale content increases southward.
		Alexandrian	Brassfield Limestone	0-10		Limestone, variable white, yellow-brown to salmon-pink, medium to coarse-texture, and fossiliferous; some dolomite and irregular shale lenses.
	Ordovician	Cincinnatian	Whitewater Formation	0-60	Increasing shale	Interbedded calcareous shale and limestone, light- to dark-gray, thin bedded; thins southward from Decatur County.
			Saluda Formation	20-50		Dolomitic limestone, gray, silty, basal coral zone; unit thins northward.
			Dillsboro Formation	~ 300		Argillaceous limestones and calcareous shales; thin, interbedded, highly fossiliferous, containing about 70 percent shale.

¹ Usage of the Indiana Geological Survey.

between 0-20 feet. The North Vernon Limestone is a fine-to coarse-grained fossiliferous limestone with bedding that varies from thick in the upper section to thin in the lower section. Below the North Vernon Limestone is the Jeffersonville Limestone. Ranging in thickness from 0-30 feet, the Jeffersonville Limestone has a lithology which varies greatly from the top to the bottom of the unit. The limestone contains laminated breccia and coral zones and has also experienced abundant calcite and pyrite recrystallization. Underneath the Jeffersonville Limestone in the stratigraphic column is the Geneva Dolomite. The Geneva Dolomite has a thickness ranging from 0-30 feet. It is characterized as a dolomite that is soft and fine-grained with a sugary texture, bedding ranges from thin at the top to thick at the bottom. Large recrystallized calcite is commonly found within the unit.

The Silurian system in Decatur County contains four units. These include the Louisville Limestone, the Waldron Shale, the Salamonie Dolomite, and the Brassfield Limestone. Units of the Silurian system underlie the north, the central, and parts of the eastern sections of the county. They outcrop in parts of the stream valleys in the same areas. The youngest of these units is the Louisville Limestone. It is found in the central and eastern sections of the county and ranges in thickness from 0-30 feet thick. The Louisville is a dolomitic limestone that is fine-grained, argillaceous, containing fossils and chert. Also it tends to be thickly bedded. The next oldest unit is the Waldron Shale. The Louisville Limestone and the Waldron Shale experi-

enced intense erosion in the middle Silurian period causing a time unconformity between the Silurian and Devonian. These two units were removed from all but 50 square miles of Decatur County [16]. The Waldron Shale is also generally found in the central and eastern sections of the county. It ranges in thickness from 0-6 feet thick and is characterized as thinly bedded, very fossiliferous, and easily eroded. The type location for the Waldron Shale is Waldron in Shelby County, Indiana. Below the Waldron Shale in the stratigraphic column is the Salamonie Dolomite with its two members the Laurel Member and the Osgood Member. The total thickness of the Salamonie Dolomite is between 0 and 90 feet. The Laurel Member is characterized as a dolomitic limestone, which is argillaceous and thick bedded with abundant chert. The Osgood Member is a dolomite or a limestone, highly argillaceous, with an increasing shale content that increases southward. The Laurel Member forms a protective cap over the older Silurian units allowing the formation of a low relief plain that extends into Kentucky [16]. The final unit of the Silurian system in Decatur County is the Brassfield Limestone. It ranges in thickness from 0-10 feet. The Brassfield is characterized as a medium to coarse-textured limestone containing fossils and lenses of dolomite and shale.

The final stratigraphic system identified as outcropping in Decatur County is the Ordovician system. The Ordovician system is composed of three units. These are the Whitewater Formation, the Saluda Formation, and the Dillsboro Formation. The Ordovician

units underlie the extreme eastern edges of the county in the preglacial valleys and also further west as erosional features. The Whitewater Formation is the youngest of the Ordovician units in the county. It ranges in thickness between 0 and 60 feet. The formation is described as an interbedded calcareous shale and limestone, which is thinly bedded and thins southward from Decatur County. The next Ordovician unit is the Saluda Formation. This formation ranges in thickness between 20-50 feet in the county. The Saluda is described as a silty dolomitic limestone containing a basal coral unit. This unit thins northward. Below the Saluda Formation is the Dillsboro Formation. The thickness of the Dillsboro is estimated to be approximately 300 feet. It is characterized as argillaceous limestones and calcareous shales, which are thinly bedded and highly fossiliferous. The formation contains approximately 70 percent shale.

The bedrock topography of Decatur County is represented in Figure 9 [18]. The bedrock surface ranges from less than 700 feet to more than 1000 feet above sea level with the highest elevation in the eastern part of the county.

GLACIAL GEOLOGY

Glacial activity has had the greatest affect upon the soil formation in Decatur County. Glacial deposits cover in excess of 90 percent of the surface area in the county [12]. The county has been affected by three of the four recognized glacial stages of North America. These are the Kansan, the Illinoian, and the

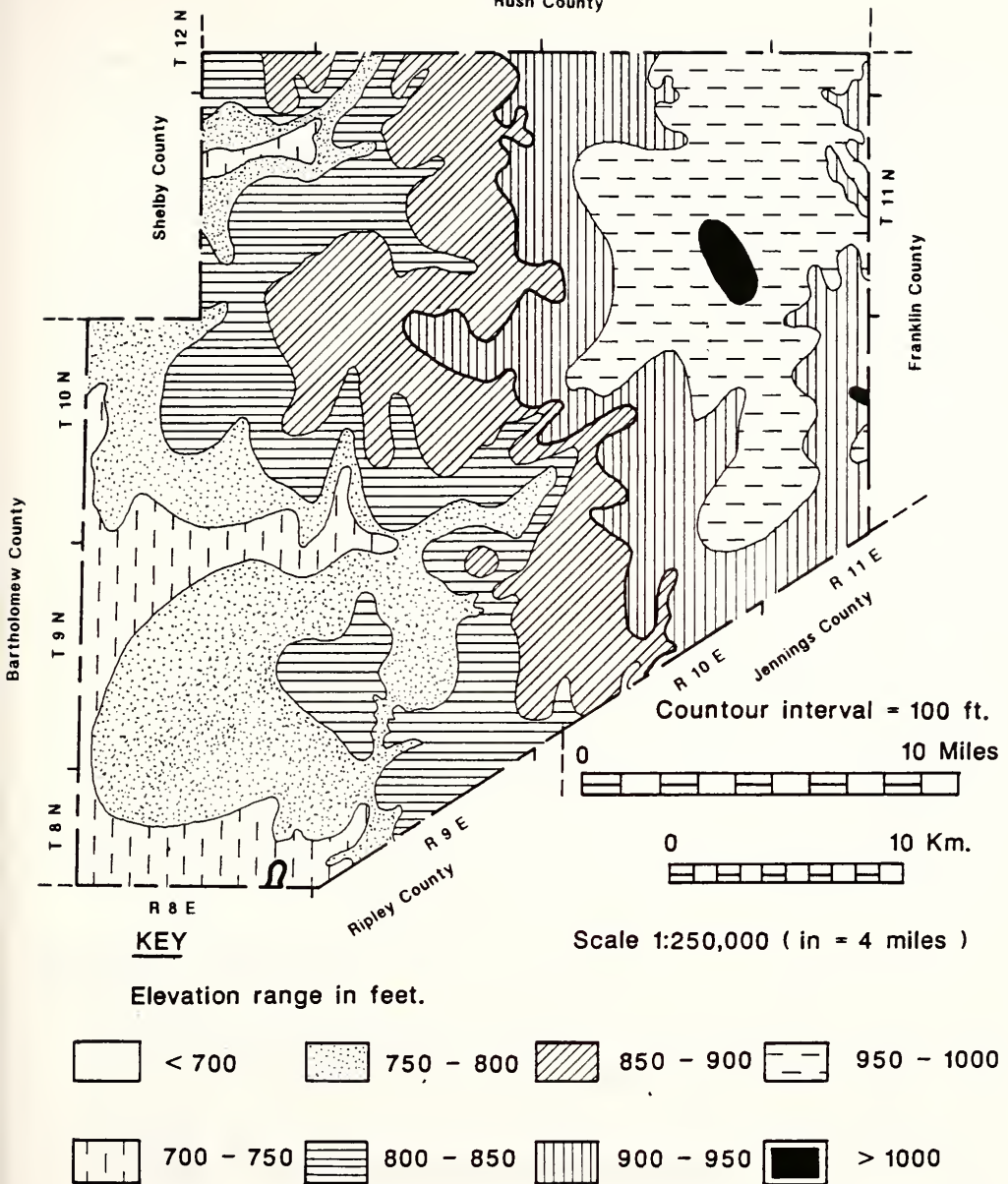


Figure 9. Bedrock Topography of Decatur County (18)

Wisconsinan glacial stages. Each stage deposited varying amount of materials in the county. An unconsolidated deposits map of Decatur County is illustrated in Figure 10 [15].

Kansan ice came from the northeast approximately 350,000 to 400,000 years ago and covered the entire county. The till deposited by the Kansan advance is part of the Jessup Formation of Indiana [19]. Kansan deposition thickness was generally less than fifteen feet. Also there was probably at least one retreat and readvance during Kansan time [19]. The final retreat of the Kansan ice was about 200,000 years ago, giving way to the Yarmouth interglacial period. A paleosol, a weathered soil profile, may be identified at some boring locations. Much of the deposited Kansan drift was weathered and eroded away during the Yarmouth and later glacial advances. Drillers logs from Decatur County have indicated the presense of pre-Illinoian deposits at a few locations [16]. These deposits may be found in deeply buried pre-glacial bedrock valleys. However, the amount of Kansan drift is, today, very sparse and of little importance.

At the end of the Yarmouth interglacial period about 125,000 years ago, another advance of glacial ice from the northeast took place. This advance is known as the Illinoian glacial advance. The Illinoian, like the Kansan, covered the entire county with ground moraine. This ground moraine, along with the action of the ice, smoothed out the landscape and filled bedrock valleys. The Illinoian glacial ice experienced at least two fluctuations as it covered Indiana. The till deposited during the stay of the

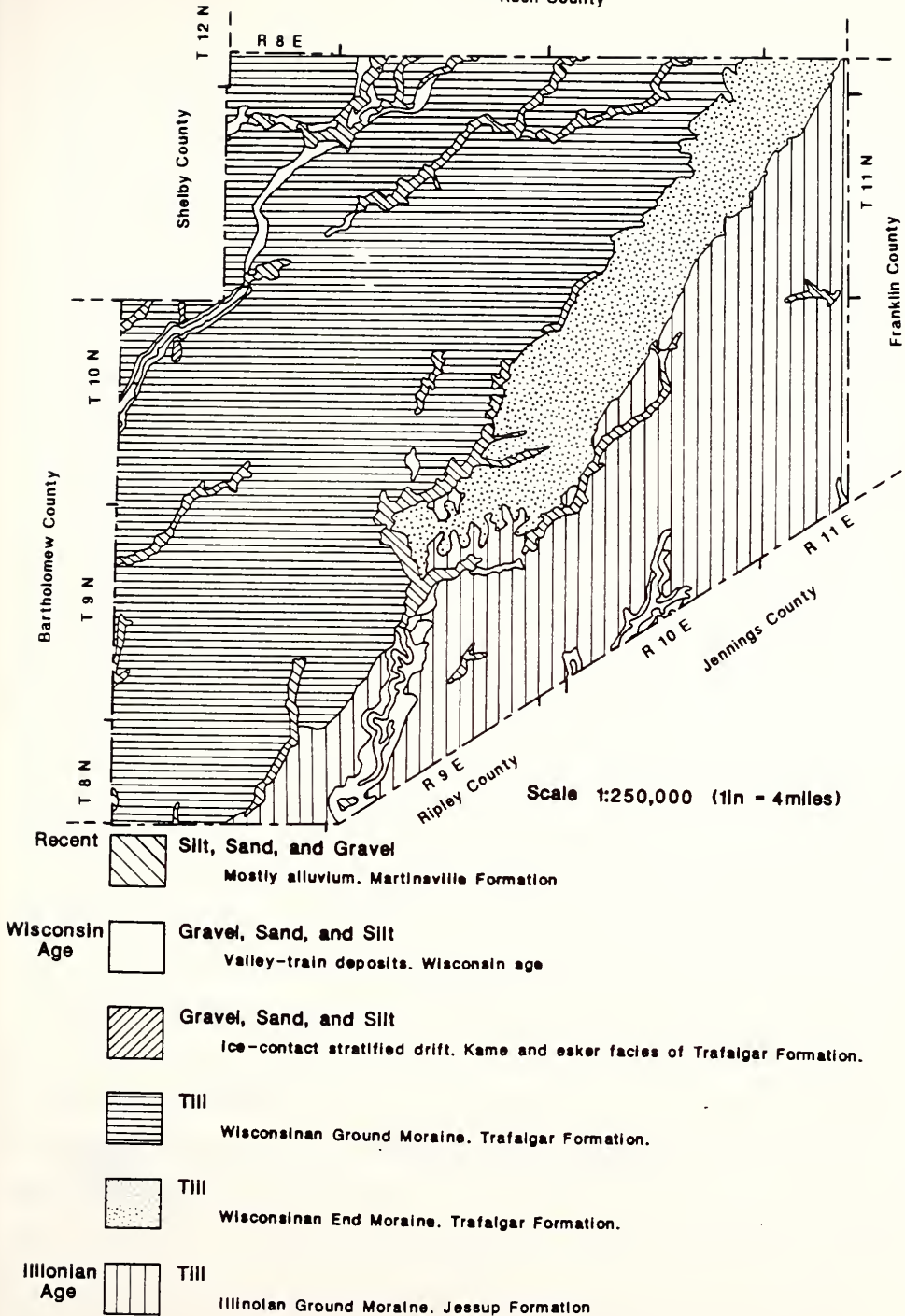


Figure10. Unconsolidated Deposit Map of Decatur County (15)

ice is the upper part of the Jessup Formation of Indiana [19]. Thin layers of paleosol may be seen within the formation indicating the fluctuations of the ice. The Illinoian ice finally retreated about 100,000 years ago leading to the Sangamon interglacial period. The interglacial period was a time of erosion and formation of outwash of the deposited Illinoian materials [20]. A paleosol during this interglacial period may be identified in some borings in the county. This paleosol has been found to be approximately two feet thick [6]. Illinoian ground moraine can be seen at the surface in Decatur County in the eastern one-third of the county. Illinoian age deposits are found, generally, in the entire county, but are covered by younger materials and Wisconsinan glacial deposits in the western two-thirds. Today, the total thickness of Illinoian and pre-Illinoian deposits in Decatur County is on the average less than 25 feet [16]. Figure 11 is a drift thickness map of Decatur County [21]. Over two thirds of the county has a drift thickness less than 50 feet and most of the eastern part of the county exhibits a drift thickness of 25 feet or less.

The final glacial stage to affect Decatur County was the Wisconsinan glacial stage approximately 65,000 years ago. Wisconsinan ice sheets, which covered Decatur County came from the northeast and covered the western two-thirds of the county. Figure 12 is the relationship of the Wisconsinan ice lobes in Indiana [22]. The Wisconsinan ice sheets advanced and retreated twice into Decatur County. Deposits laid down by the ice are

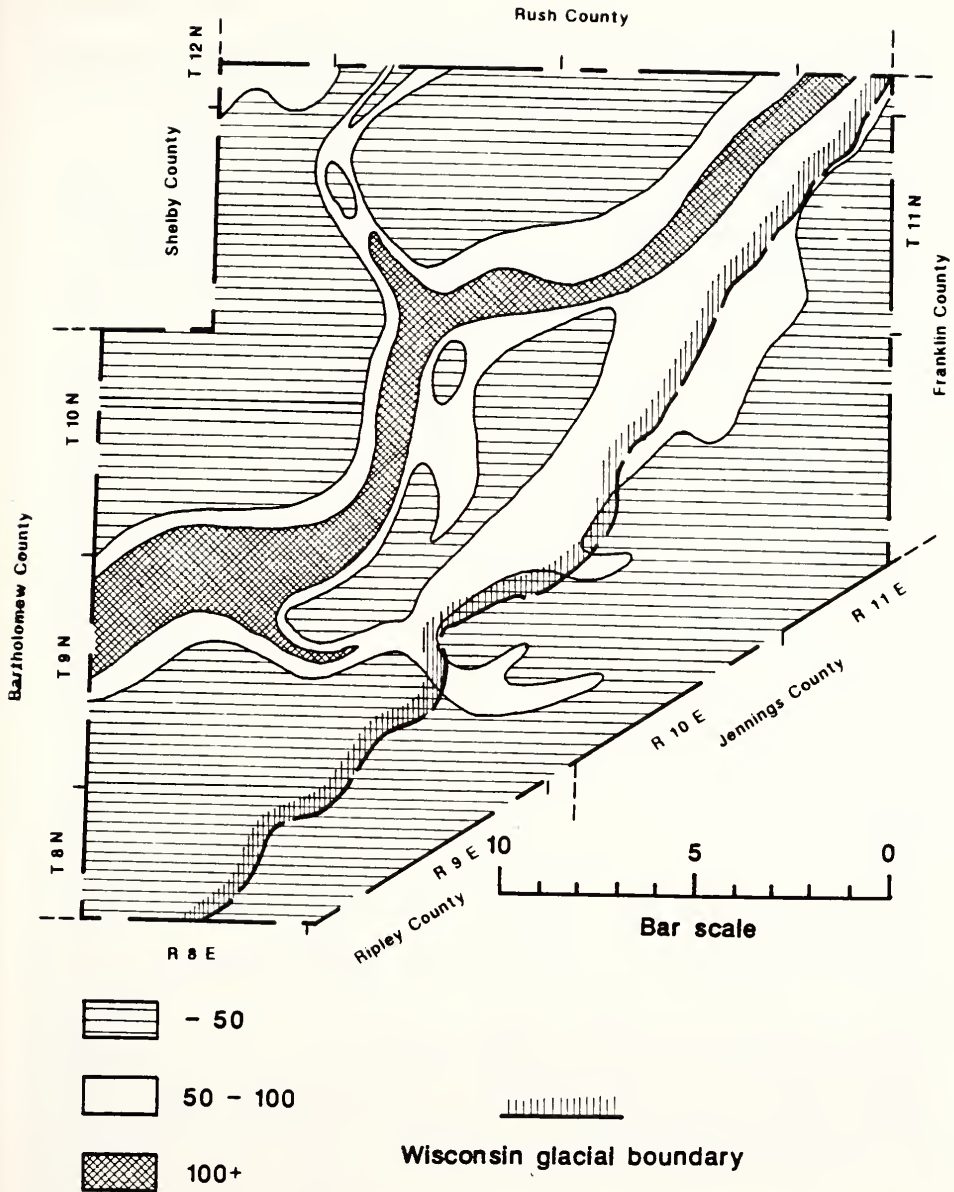


Figure 11. Drift Thickness Map of Decatur County (21)



Figure 12. Relationship of Wisconsinan Ice Lobes of Indiana (22)

generally less than thirty feet thick. In one boring in the Wisconsin area total thickness of glacially deposited material was found to be 141 feet [16]. Refer to Figure 11 for thickness of drift in Decatur County. The first advance and the farthest advance into the county is marked by the Shelby Moraine at the Wisconsin-Illinoian boundary. As the ice melted back the first time, this ridge moraine was left along with the ground moraine and other glacio-fluvial materials. The second advance was to a position approximately two miles east of St. Paul in Shelbyville County. As this ice retreated about 12,000 years ago, the Crawfordsville Moraine, along with a boulder belt close to Germantown, was laid down [23]. Only slight topographic evidence can be seen in the field to call this particular area a ridge moraine. Thus it was mapped as a Wisconsin ground moraine area in agreement with certain other authors [15].

The farthest extent of the first advance of Wisconsin glaciation in the county is marked by the Shelbyville Moraine. This point was reached approximately 21,000 years ago and is seen as a ridge moraine in Decatur County. The moraine defines the boundary between the Wisconsin - Illinoian surface deposits in the northern two-thirds of the county down to Gaynorsville. Some authors have mapped the Shelbyville Moraine all the way down to the southern border of Decatur County. However, the evidence is not there for mapping the Shelbyville Moraine any further south than Gaynorsville [15].

Behind the ridge moraine, the ice deposited glacial and glacial-fluvial materials. The Wisconsin deposited till is part of the Trafalgar Formation of Indiana [22,23]. The most widespread of the glacial materials deposited is the Wisconsin ground moraine. Topographically high conical hills of deposited fluvial materials on top of the glacier known as kames were laid down as the glacier melted. These are found close to St. Omer and Adams in Decatur County. Also deposited by the ice was an esker. Eskers form by the accumulation of coarse textured material in a fluvial channel within a glacier. When the glacier later melts away, the esker remains as a winding ridge. The Burney esker in Decatur County is located about one mile northwest of Burney. Kames and eskers are characteristic of stagnant and slowly melting glaciers. Figure 13 is a map of glacial deposits of central Indiana [22].

As the Wisconsin ice retreated, large amounts of water and materials scoured the stream channels. Terraces were built by the reworking of the till. In one location, an abandoned glacial sluiceway which once carried glacial meltwaters was found surrounded by glacio-fluvial terraces [24]. Today, the stream channels affected by glacial meltwaters are in most cases underfit. Strong winds picked up silt-sized particles and deposited loess upon the surface of the county. The depth of this loess is, however, generally less than two and one-half feet thick.

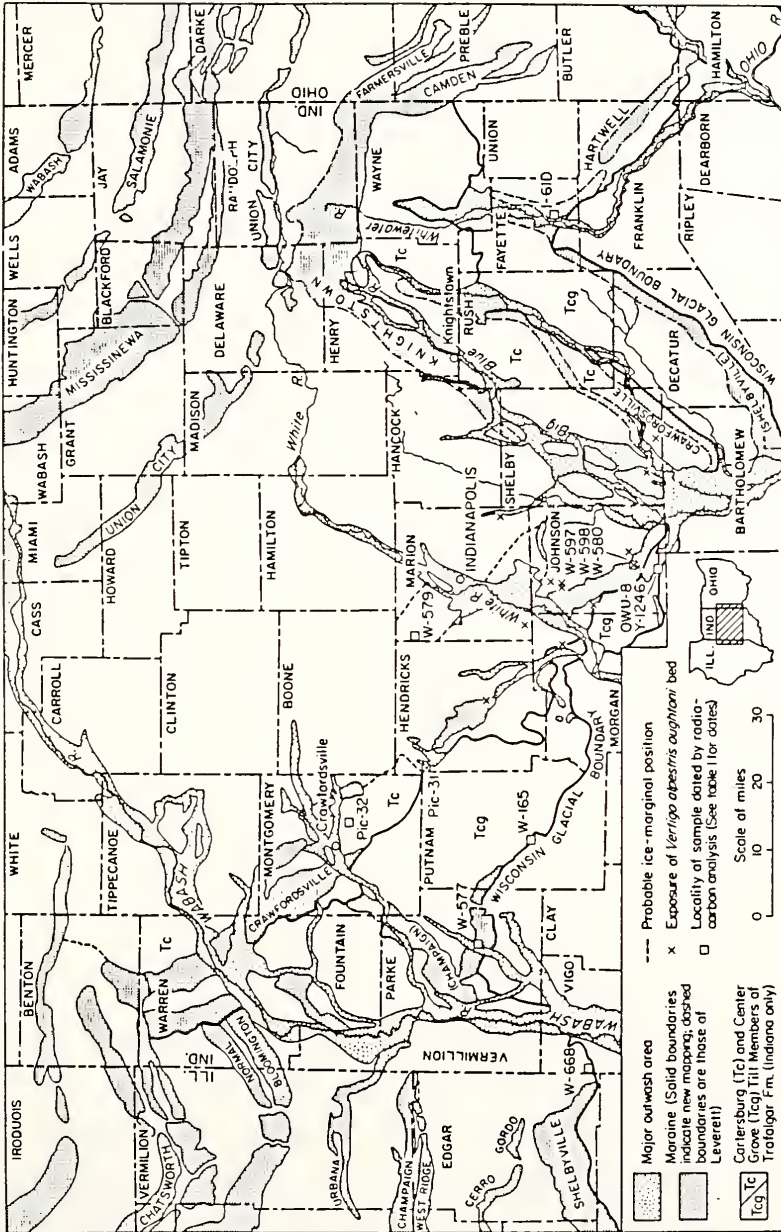


Figure 13. Map of Glacial Deposits in Central Indiana (22)

LANDFORMS AND ENGINEERING SOIL AREAS

EOLIAN LANDFORMS

No major landforms of eolian drift, such as sand dunes, exist in Decatur County but a blanket of loess of varying thickness occurs throughout the county.

Loess Plain

Loess covers most of Decatur County except for steep eroded slopes and recent alluvial deposits. The loess is, however, not thick enough to be mapped as a distinct parent material type. Total thickness in the county is less than 2.5 feet. Wisconsinan age drift has less than two feet of loess. The Illinoian ground moraine has as much as 2.5 feet of loess. Table 5 contains the names of soil series which form partially over loess and the underlying parent material type [2].

Table 5. Agricultural Soil Series Formed Partially in Loess and the Underlying Parent Material in Decatur County [2].

Illinoian Ground Moraine	Wisconsinan Ground Moraine
Avonburg (20-50")	Crosby (5-18")
Cincinnati (18-40")	Cyclone (40-60")
Clermont (24-60")	Fincastle (20-40")
Grayford (6-24")	Miami (5-18")
Hickory (<18")	Russell (22-36")
Rossmoyne (18-35")	Williamstown (4-19")
Ryker (24-40")	Xenia (22-36")

Loess soils are generally silt loam or silty clay loams. Due to the non-cohesive nature of the loess soils, highway subgrade and fill problems are common. These problems include collapse upon wetting, piping, frost heave, and pumping. Since the loess

is in combination with underlying glacial materials, these problems may be less severe.

GLACIAL LANDFORMS

Glacial landforms make up in excess of 90 percent of the parent material accumulations in Decatur County. The types of glacial parent materials mapped are Wisconsinan ground moraine, Wisconsinan ridge moraine, Illinoian ground moraine, thin Illinoian ground moraine over limestone, and thin Illinoian ground moraine over limestone and shale.

Wisconsinan Ground Moraine

Wisconsinan-age ground moraine occupies approximately 60 percent of the surface area of the county. The ground moraine is characterized by a gently undulating surface forming an extensive plain. Local relief is generally less than 10 feet but exceeds 15-20 feet in a few of the dissected stream valleys. On the aerial photography, the ground moraine showed typical light-dark mottled patterns [25]. Most of the gullies in the area are of the broad saucer shape with low gradient indicating silty clays and silty loams common with thin loess cover. The loess thickness ranges from 0-5 feet, but generally is less than two feet [2]. Generalized soil profiles for the Wisconsinan ground moraine and the other parent material types may be found on the left hand side of the engineering soils map of Decatur County. These profiles were produced using available agricultural and borehole information. The soil profiles show expected variations in the

material to a depth of 12 feet.

The soil profiles for the Wisconsin ground were divided into two categories. The categories are high and low ground moraine. These represent generalized subsoil conditions in the rises and in the basins of the Wisconsin till plain. In Wisconsin ground moraine areas, the surface soil is a silty loam down to a depth of 8-15 inches. The low ground moraine usually contains less than 8 percent organic matter [2]. The silty loam is underlain by silty clay loam and clay loam down to 42 inches in the high ground moraine and down to 52 inches in the low ground moraine. These soils are underlain by loamy soils with trace amounts of sand and gravel throughout. The low ground moraine generally contains a higher clay content in its subsurface soils versus the high ground moraine.

The agricultural soil series in Decatur County that form in Wisconsin ground moraine are: Crosby, Cyclone, Fincastle, Hennepin, Miami, Russell, Williamstown, and Xenia. Appendix C-1 contains a table of engineering soil properties for the soils of Decatur County. No locations for the sampling of the different soils are given [2]. Appendix C-2 contains a Table of physical and chemical properties of Decatur County soil [2]. Appendix D contains soil boring at various locations in Decatur County as indicated on the engineering soils map. Borehole numbers 1,3,8,17 and 18 are in Wisconsin ground moraine areas.

Wisconsin Ridge Moraine

Ridge moraine of Wisconsin age was mapped along the boun-

dary between Wisconsinan and Illinoian glacial drift. The moraine starts in the northeast corner of the county and stretches towards the southwest in a generally continuous band approximately one-half to two miles wide. The terminus of the moraine is close to Gaynorsville, in south-central Decatur County. Other sources have mapped the ridge moraine as far south as Sardinia. The ridge moraine rises as much as 30-40 feet above the surrounding flatter areas. Its rolling topography forms the distinct boundary between the Wisconsinan and Illinoian drift sheets.

On aerial photography, the ridge moraine showed a highly mottled tone. The drainage was dendritic with saucer-shaped gullies. The soil profile in the ridge moraine is similar to the ground moraine. Silty loam (A-4 to A-6) is the surface soil down to 6-8 inches. Underlying this is subsoils of silty clay loam or clay loam (A-6) down to 30 inches. Finally, loam with sand, gravel, and cobble seams may be encountered at depth. Agricultural soil series mapped as ridge moraine include Crosby, Cyclone, Fincastle, Miami, Russell, Williamstown, and Xenia.

Illinoian Ground Moraine

Illinoian-age ground moraine occupies approximately 20 percent of the surface area of the county. The ground moraine is buried beneath the Wisconsinan glacial drift of the western two-thirds of the county. The Illinoian ground moraine is characterized by a nearly flat to highly dissected, rolling topography.

Bedrock fairly close to the surface and gully erosion produces the rolling landscape. The Illinoian ground moraine is cut by numerous deep gullies and cracks. This contrasts with the very limited dissection on the Wisconsinan ground moraine. Weathering of the ground moraine is as deep as 15 feet or more over the flat areas.

On the aerial photography, the Illinoian ground moraine appears as a flat area with dark photo tones. The gullies are dark-centered and have a characteristic white fringe about them [25]. Gullies are generally of the deep saucer type.

Most of the Illinoian ground moraine has a cover of weathered loess of 2 to 4 feet thick. This loess tends to be of medium stiffness. Two sets of engineering test data are given in table 6a and 6b. Table 6a is from a flat area of Illinoian ground moraine in nearby Bartholomew County [26]. Table 6b is from a dissected area of Illinoian ground moraine in nearby Jennings County [27]. The Bartholomew County sample is weathered down to 143 inches. Below this depth, the sand content increases and the silt content decreases. The Jennings County sample is, as would be expected by its topographic location, weathered to a shallower depth than the other sample. The sample is unweathered below 85 inches. Both of these soils contain a clay rich horizon below approximately two feet, which is common with some Illinoian ground moaines.

The surface soils of the Illinoian ground moraine are a

Table 6a. Engineering Test Data from a broad, flat area of Illinoian Ground Moraine (NW, SW, sec.14, T.8N., R.5E., Bartholomew County) (2).

Clermont silt loam											
depth inches	Grav %	Sand %	Silt %	Clay %	LL %	PI %	AASHO	UNIFIED	Wopt %	Max	yd pcf
0-7	1	17	77	5	25	1	A-4(10)	ML	15		108
7-16	4	13	69	14	25	4	A-4(2)	ML	15		113
16-24	-	7	63	30	34	14	A-6(16)	CL	16		107
24-35	-	12	64	24	39	17	A-6(14)	CL	18		106
35-70	1	14	63	22	31	12	A-6(9)	CL	15		111
70-110	2	15	64	19	27	13	A-6(8)	CL	16		112
110-143	2	29	56	13	32	15	A-6(8)	CL	17		111
143-200	9	39	44	8	19	4	A-6(0)	ML	17		124

Table 6b. Engineering Test Data from a dissected area of Illinoian Ground Moraine (NW 1/4, NW 1/4, sec.10, T.6N. R.8E. Jennings County) (2)

Rossmoyne silt loam											
depth inches	Grav %	Sand %	Silt %	Clay %	LL %	PI %	AASHO	UNIFIED	Wopt %	Max	yd pcf
3-9	2	13	58	27	30	7	A-4(8)	ML	15		108
27-43	10	16	44	30	26	9	A-4(8)	CL	16		112
85-129	5	28	30	37	32	13	A-4(8)	CL	18		109

weathered loess (A-4) down 2 to 4 feet. This is shown as a silty loam on the engineering soil profile. Subsurface soils consist of silt loams (A-4) grading into unweathered loams (A-6), silt loams, and clay silt loams (A-4 to A-6). Agricultural soil series which form on Illinoian ground moraine include Avonburg, Cincinnati, Clermont, Hickory, and Rossmoyne.

Thin Illinoian Drift over Limestone

In some of the severely eroded stream valleys of the Illinoian drift section of the county, the Illinoian ground moraine is very thin. Where this thin ground moraine lies over the Silurian-age limestones, a distinct photo pattern exists. The underlying limestone exhibits a rounded, blocky form with sinkholes. As with the Illinoian ground moraine, white fringes occur along the gullies. However, these are not as well developed as in the regular ground moraine areas. Along sections of Sand Creek large concentrations of sinkholes exist.

The surface soils of this landform type are usually silty loams (A-4). Up to two feet of loess may be found on these slopes. Underlying soils include silt loams (A-4), clay loams (A-6), and loams down to 4.5 to 10 feet. Beneath these are Silurian-age limestones. The upper few inches of the limestone is generally weathered. Soil series which form on thin Illinoian ground moraine over limestone includes Avonburg, Cincinnati, Clermont, Grayford, Hickory, Rossmoyne, and Ryker. Borehole numbers 13 and 16 are on thin Illinoian ground moraine over lime-

Thin Illinoian Ground Moraine over Limestones and Shales

The areas mapped as thin Illinoian ground moraine over limestone and shale occur on the eastern side of Decatur County. This thin ground moraine covers Silurian-age limestones and Ordovician-age limestones and shales in the severely eroded stream valleys. These valleys are generally quite expansive. The largest quarry in Decatur County quarries Silurian-age limestones covered by thin ground moraine just north of New Point. Also, the largest lake in Decatur County, Lake Santee is found in this landform type.

Surface soils in this thin ground moraine are silty loams (A-4) and loams up to 1.5 feet thick. Most of these are due to loess cover ranging from 0-2 feet thick. Underlying soils include clay loams (A-6), silty clay loams (A-4 to A-6), and silty loams (A-4) down to as much as 12 feet. Interbedded limestones and shales are encountered at depths ranging from 3 to 12 feet below the surface. The agricultural soil series which form on thin Illinoian ground moraine over limestones and shales include Avonburg, Cincinnati, Clermont, Grayford, Hickory, and Rossmoyne.

RESIDUAL LANDFORMS

Limestone Bench

Soils which form on limestone benches are characterized as

residual soils. They are located in the northwestern section of the county. The benches line a major portion of Clifty Creek downstream from Adams. Also benches are found on Flatrock River close to St. Paul and Fall Fork Clifty Creek on the county line northwest of Waynesburg.

The residual soils on limestones benches are poorly developed. The soils are in some cases covered by Wisconsinan ground moraine or in steeper valleys, by slopewash. In other areas, soil development may be almost lacking due to frequent flooding and erosion.

The surface soils on the limestone benches are generally 7 to 14 inches of silty loam (A-4) or silty clay loam (A-6). Underlying soils are usually clay loams (A-7) with traces of limestone fragments down as deep as four feet. Limestone bedrock is generally encountered from 1 to 4 feet below the surface. However, where there is intense erosion, limestone may outcrop. The agricultural soil series which form over limestone benches include Corydon, Millsdale, and Milton.

GLACIO-FLUVIAL LANDFORMS

Kames

A total of eight kames were found in Decatur County. Kames form the most prominent topographic features in the county. The largest of these kames is the Adams kames rising 65 feet above

the surrounding plain. Kames are of glacio- fluvial origin providing limited sources of sand and gravel. Two of the kames near St. Omer have been utilized as a sand and gravel source. The kame near Adams has not been utilized as an aggregate source and may contain a large portion of finer materials.

The first one to four feet of the surface material of the kame is generally mixed. These soils are generally silts, sandy silts, sandy clay silts, or sandy silt loams with trace amounts of gravel. Underlying these surface soils are stratified layers of sandy silts, sands, and gravelly sands. Kames do not provide a major aggregate source but may provide small supplies. Care must be taken with the excessive amounts of silt found in some kames. The agricultural soil series which form on kames include Fox, Martinsville, and Ockley.

Eskers

Eskers are glacio-fluvial materials deposited in the internal streams and rivers within a glacier. They generally contain stratified sands, silts, and gravels. The only esker found in Decatur County is located 1.5 miles northeast of Burney. The soil profile will be much like the kames except surface soil development will be shallower. There was evidence in the field that the Burney esker may have been used as an aggregate supply at one time. The agricultural soil series which form on eskers include Fox, Martinsville, and Ockley.

Terraces

Areas mapped as terraces are found in the Wisconsin drift

areas. The terraces were built primarily as large quantities of meltwaters flowed through the streams and abandoned waterways of the county. Large terraces are found along Flatrock River, Clifty Creek, Fall Fork Clifty Creek, Sand Creek, and along the abandoned glacial sluiceway. Terraces contain coarse-grained materials. Thus, they have very high permeability and no surface drainage. Current scars were observed on these extremely flat landforms. These airphoto pattern elements, along with their 5 to 15 feet height above the flood plains, were used to identify the terraces on the aerial photographs.

Surface soils include silt loams (A-4), silty clay loams (A-4 to A-6), and loams down to about four feet. Underlying soils include gravelly loam, gravelly sand loam, or sand loam. Agricultural soil series which form upon terraces include Fox, Martinsville, and Ockley. Engineering test data taken from nearby Shelby County for Fox and Ockley soils are given in tables 7a and 7b [28].

Glacial Sluiceway

An abandoned glacial sluiceway was mapped in the northwest corner of Decatur County. During the retreat of the Wisconsin glacialiation, the sluiceway served as a drainageway for the heavy volume of meltwater. The sluiceway appears to have connected Flatrock River to Clifty Creek but is now at a much higher topographic position than these streams. In sections, the sluiceway

Table 7a. Engineering Test Data from a Terrace (SW, SW,
sec.35, T.5N., R.5E., Shelby County) (2)

Ockley loam										
depth inches	Grav %	Sand %	Silt %	Clay %	LL %	PI %	AASHTO	UNIFIED	Wopt %	Max yd pcf
0-7	1	39	47	13	26	9	A-4(5)	SM-SC	14	116
27-35	18	37	15	30	60	42	A-7-6(9)	SC	14	112
46-60	56	36	4	4	NA	NA	A-1-a(0)	SW-SM	10	126
At another location (SW, NE, sec 14, T.13N., R.5E., Shelby County)										
depth inches	Grav %	Sand %	Silt %	Clay %	LL %	PI %	AASHTO	UNIFIED	Wopt %	Max yd pcf
0-8	6	40	52	2	32	9	A-4(4)	ML-CL	16	109
16-29	23	39	16	22	47	27	A-7-6(5)	SC	16	110
46-56	17	68	7	8	NA	NA	A-1-b(0)	SM	12	117

Table 7b. Engineering Test Data from a Terrace (NE, sec.1,
T.9N., R.5E., Bartholomew County) (2).

Fox loam										
depth inches	Grav %	Sand %	Silt %	Clay %	LL %	PI %	AASHTO	UNIFIED	Wopt %	Max yd pcf
0-7	3	47	46	4	24	5	A-4(0)	ML	15	112
7-13	6	52	29	13	29	10	A-2-6-(1)	CL	13	116
13-26	13	55	14	18	34	12	A-4(8)	CL	18	110
26-33	11	71	11	7	NA	NA	A-3	SM	12	119
35-60	34	62	4	--	NA	NA	A-3	SW	10	112

is greater than one-quarter of a mile in width. Large outwash terraces were built along its sides. Some of these contain sand and gravel pits.

On the aerial photography, the sluiceway appears very flat with a dark tone and a silty texture. A single drainage ditch flows through the center of the abandoned drainageway. At one time, parts of the sluiceway were in a swampy condition. Thus surface soils may contain up to eight percent organic matter [2]. Surface soils of the sluiceway are loam, silty loam (A-4), and sandy clay loam down to about 30 to 36 inches. These are underlain by clay loam (A-6) and sandy clay loam with a trace of gravel to 42 inches. Under this is sand with seams of gravel. Agricultural soil series which form over the glacial sluiceway include Montgomery soils.

FLUVIAL LANDFORMS

Flood Plains

Areas mapped as flood plain in Decatur County vary in width from a few hundred feet in small tributaries to approximately one mile. Soils in flood plains can be locally, very variable, making characterization difficult. But there are some differences in the flood plains in Wisconsinan drift areas verses Illinoian drift areas making them worthy of separate characterization. Thus, the soil profile of flood plains were divided into these two areas.

A.) Flood Plains in Wisconsinan drift areas

Soils of the flood plains in Wisconsinan drift areas are derived from the erosion of thin loess, outwash materials, Wisconsinan ground moraine, and residual bedrock. The flood plains in these areas attain widths up to one mile. These widths are generally greater than are found in Illinoian areas. In many sections of Clifty Creek, where limestone benches occur on both sides of the stream channel, the flood plain width was slightly enlarged for mapping purposes.

The first 14 to 24 inches of the flood plain soils are silty loams (A-4), organic clay loams (A-6), or organic silty clay loams (A-4 to A-6). The clay loam contains a higher organic content than the silty clay loam, up to six percent. Underlying these soils down to 32 to 72 inches is loam, which is silty and/or clayey in sections. This grades into a gravelly sand loam or a gravelly sand. In some flood plains, limestone is encountered as close as six feet below the surface. Agricultural soil series which form on flood plains in Wisconsinan drift areas include Chagrin, Chagrin Variant, Lobdell, Orrville, Sloan, and Stonelick. Borehole numbers 2,4,5,7,9,10,11,12,19 and 20 are on flood plains in Wisconsinan drift areas.

B.) Flood Plains in Illinoian drift areas

The flood plains in Illinoian drift areas contain soils which are derived from Illinoian ground moraine, thin loess, residual bedrock, and drift washed in from the Wisconsinan area. Most flood plains in the Illinoian area are a few hundred feet or

less in width. The exceptions to this are Cobbs Fork Sand Creek and sections of Sand Creek which are both approximately one-quarter of a mile in width.

The surface soils in Illinoian drift areas are silt loams (A-4) to a depth of 12 to 60 inches, silty clay loam (A-4 to A-6) to a depth of 12 inches, and clay loam (A-6) to a depth of 10 to 14 inches. In Illinoian areas mapped as ground moraine, underlying soils include loam with silt and clay seams down to 36 inches and a sandy loam with a trace of gravel. Flood plains mapped as Illinoian drift over limestone may have two possible profiles. These are silt loam lying directly over limestone at a depth of 36 to 60 inches or silt loam underlain by a gravely sandy loam at 16 inches covering limestone at a depth of 48 to 60 inches. Finally, flood plains in areas mapped as drift over limestones and shales may also have two possible profiles. Surface soils are underlain by a sandy loam at 16 inches. The sandy loam covers interbedded limestones and shales at a depth ranging from 48 to 72 inches.

Agricultural soil series which form in Illinoian drift area flood plains include Chagrin, Lobdell, Orrville, Sloan, and Stonelick. Borehole numbers 14 and 15 are on flood plains in Illinoian drift areas.

MISCELLANEOUS LANDFORMS

Gravel Pits and Quarries

Several gravel pits and one major limestone quarry are found in Decatur County. The gravel pits are found in the northwestern section of the county in the terraces and kames of the Wisconsin drift area. These pits produce an adequate supply of sand and gravel aggregate. The limestone quarry located north of New Point produces crushed stone and agricultural lime, mostly from the Silurian-age strata. Other quarries have been located along Sand Creek in the Silurian-age limestones.

ENGINEERING PROBLEMS OF DECATUR COUNTY

INTRODUCTION

This section is a discussion of possible engineering problems associated with the landform-parent material areas mapped in the county.

GROUNDWATER SUPPLY

Decatur County, like some of its neighbors, has found it difficult to develop adequate groundwater sources [16]. Larger towns like Greensburg and Westport have developed surface supplies to ensure an adequate water supply. But 70 percent of the population of the county must rely on groundwater for their needs. This has caused economic restrictions in some rural areas because water is needed for progress.

There are several rock stratigraphic units which are water yielding. These include the Devonian limestones and dolomites, the Silurian-age Louisville limestone, and the Ordovician-age Saluda Formation. Wells drilled into these aquifers will yield water at a rate ranging from 0 to 250 gpm [16]. However, in areas where the upper sequences have been eroded away, drilling the older sequences of siliceous dolomites give extremely low water yields.

Limestones and dolomites contain between 4 to 30 percent water filled voids. But they can not yield water at an adequate,

continuing rate if fracturing and dissolution of the rock is not present to allow water movement between the voids. When the water is used in that particular void, water yields drop almost to nothing. Thus, a study of fractures and lineament traces is helpful in locating drilling locations that will produce adequate yields. Figure 14 is a fracture and lineament trace map of Decatur County. The traces shown on the map are the most prominent ones in the county. Drilling near these traces or at the intersection of two or more traces gives a greater probability of adequate domestic water yields.

Several possible problems should be considered when using the fracture trace map to locate wells. First, most of the traces follow natural drainageways and may be hundreds of feet from the site needing a water supply. Thus, cost of piping should be balanced with the cost of drilling wells. This is especially true in the eastern part of the county, where many inadequate wells have been drilled. Secondly, since these lineaments are located near surface drainageways, site preparation for drilling may be costly. Next, drillers may encounter deflection of their drill bits by hard loose rocks in the fractures. Finally, the length of casing may need to be increased due to mud slumping inside the lineaments.

For drilling in fracture areas, the following techniques are helpful. First, the highest water yields are found in a 100 foot radius of the fracture. Thus, drilling directly upon fractures is not recommended. This eliminates most of the drilling problems.

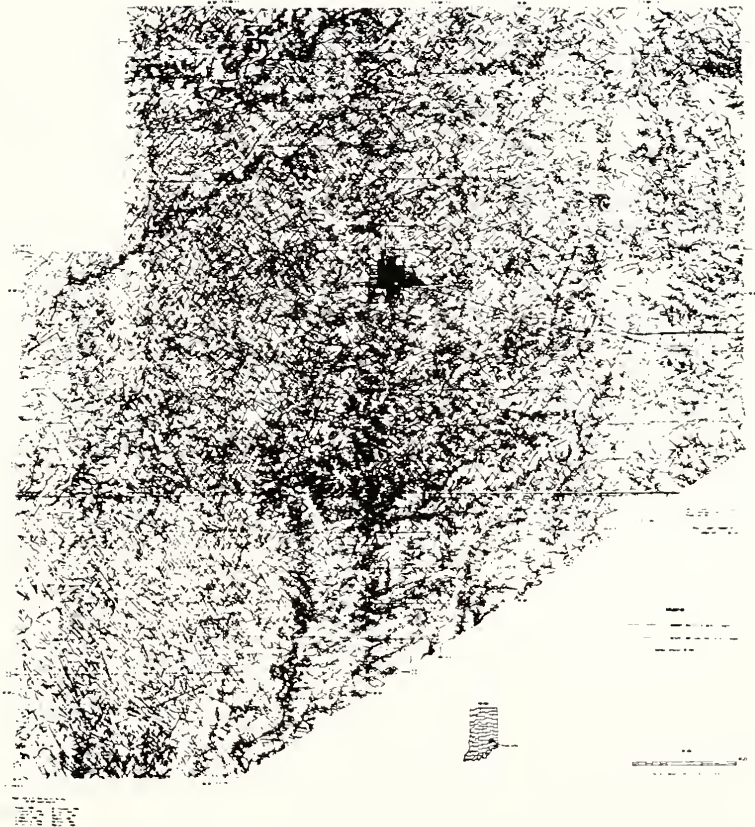


Figure 14. Fracture Trace and Lineament Map of Decatur County (16).

Finally, drilling close to fracture traces generally give adequate water yields within 125 to 150 feet of the surface. Thus, the need to go much deeper when locating wells by the fracture trace method is not necessary.

FROST ACTION POTENTIAL

Several parent material types have a moderate or high probability for frost heave. These are the Wisconsinan ground moraine and ridge moraine, the Illinoian ground moraine, and the thin Illinoian moraine over bedrock. All of these may contain substantial amounts of clays and especially silts. They are generally poorly drained and thus are susceptible to frost action. Frost heave during freezing and induced low shear strength during thawing can damage rigid structures, such as pavements. Care should be taken to provide either adequate drainage and/or increased insulating materials to frost susceptible soils.

CONSTRUCTION MATERIALS

Decatur County contains several gravel pits and one major limestone quarry supplying an adequate aggregate supply. However, these pits and quarries are not centrally located. Thus, transportation of the aggregate to all areas is costly.

Crushed limestone from the quarry located north of New Point is a major source of aggregate and, at times, building stone. Chert is a detrimental component in some of the limestone rocks of Decatur County. The Laurel limestone is generally not a good

aggregate due to its porous chert content. Other unsatisfactory aggregate materials include the Waldron Shale due to its easily eroded nature, the Osgood dolomite due to its abundant chert, the Jeffersonville limestone if carbonaceous laminae are present, and the upper layer of the Louisville limestone due to abundant silt. Probably the best aggregate available is the Geneva limestone. Table 8 contains typical physical properties of some Devonian and Silurian strata [29].

Table 8. Typical Range of Physical Properties of Some Devonian and Silurian Strata from Eastern Indiana [29].

Unit	Specific Gravity	Abrasion Loss (%)	Soundness (%)	Absorption (%)
Jeffersonville	2.64-2.71	23.2-31.8	3.6-45.7	0.9-2.70
Geneva	2.34-2.68	33.3-35.3	7.54-12.0	2.34-4.8
Louisville	2.54-2.76	23.4-35.6	6.8-33.03	1.1-2.7
Laurel	2.69-2.80	23.5-29.1	4.0-39.8	0.5-2.74
Brassfield	2.69-2.75	28.3-29.0	6.3-8.03	1.1-1.4

Gravel pits are common in the terraces along Flatrock River and Clifty Creek. Also, several of the kames located near St. Omer have been utilized as sand and gravel sources. These pits offer good materials for roadfill and other aggregate requirements. Care should be taken when exploiting kame sources due to possible excess silts and fines.

STEEL AND CONCRETE CORROSION

Forty percent of the parent materials contain soils with a

high to moderate steel and concrete corrosion potential. These include the Illinoian ground moraine, thin Illinoian drift over bedrock, flood plains in Illinoian drift areas, and limestone benches. The pH of these soils range between 4.5 to 8.4 [2]. Acidic conditions present in these soils will reduce the lifespan of buried metal pipe from 40 to 15 years [30]. Aluminum pipe is often used to minimize the corrosion effects. This is the case in Bartholomew County [31]. It should be emphasized that site specific evaluation of potential metal corrosion should be considered.

Most severe concrete corrosion is due to a poor quality of concrete. Thus in areas where this is potentially a problem, good quality concrete helps to eliminate corrosion and structural damage.

WASTE DISPOSAL

There are many landform types in Decatur County which should be avoided when planning for a waste disposal system. First are the terraces and the eskers and kames. They are much too permeable to ensure proper confinement of waste materials. Next, floodplains and drainageways experience flooding, which would lead to seepage and contamination. Finally, areas with bedrock close to the surface such as limestone benches and thin Illinoian drift over bedrock. Cracks and fractures in the rocks increase permeability and allows for rapid movement of the contaminates away from the site. Wisconsinan and Illinoian ground moraine are

the best choices for location of waste systems. They have, generally, low permeability and offer good cover material due to their fines content.

FOUNDATIONS AND EXCAVATIONS

Almost all of the soils in Decatur County have a low probability of associated problems with foundations and excavations. Areas which generally experience moderate problems with foundations and excavations include the floodplains, the limestone benches, and possibly the thin Illinoian drift over bedrock areas.

Foundation and excavation problems are common in the flood plain areas. The flood plain soils are highly permeable and require dewatering. Excavations often experience slope failure thus there is a need for adequate bracing of the slopes. Blowouts due to water pressure are another common problem which should be anticipated. In these areas, bedrock is relatively close to the surface and foundations should rest upon bedrock.

On limestone benches, the number one problem will be sink holes. Without proper design, foundation collapse can cause great damage. Sink hole development and solutioning is a problem that only gets worse; thus, proper fill and drainage structures are needed.

In Illinoian drift areas over bedrock, two potential problems may occur. First, sink holes and solution cavities are

common in these areas, especially near Sand Creek. Second, exposure of the interbedded limestones and shales in the eastern part of the county can cause shale degradation and slope failures. Steps should be taken to protect the shale from the environment, when the possibility of degradation exists.

Other potential problems of the engineering soils of the county include perched water tables and ensuing slope stability problems in the ridge moraine. There is the need for dewatering in terrace excavation. Also, terraces should be explored for local loose sand seams or clay pockets.

Few problems are anticipated with building of structures and excavation of materials in the Wisconsin and Illinoian ground moraine areas. The heaviest buildings in Decatur County are located in Greensburg. The soils under Greensburg, for the most part are, Wisconsin ground moraine. These moraines are naturally overconsolidated, an important point for consolidation and settlement considerations. To ensure proper foundation performance, a careful site investigation should be undertaken to alleviate future problems. Glacial till can be very variable over a short distance. Soil exploration for new buildings in these areas is needed for identification of materials with low bearing capacity and high settlement potential.

SHALE EMBANKMENT AND DEGRADATION

Shales occurring in Decatur County could cause problems if used in embankments. Testing of shale materials to be used in

rock fills to check their tendency to degrade after placement are required. When these materials are placed and compacted, large voids exist. As the shale is exposed to the environment, it becomes soft and its collapsing void spaces cause large settlement and slope failure. Fortunately, a rating system has been devised to determine the shale suitability as a fill material [32]. Specific tests are performed upon the shale to rate it for comparison with correlation charts. These charts correlate the shale rating with common design practice.

The first test performed upon the shale is the slake durability test. This test evaluates durability and long term degradation due to weathering. Five ten-gram samples of shales are placed in a wire drum, submerged half-way in water, and rotated 200 revolutions. The drum is then oven dried before repeating the rotation. After the second set of rotations, the pieces of shale remaining are weighed. The shale durability index, $Id(2)$, is then computed as follows:

$$Id(2) = \frac{\text{Weight after second cycle} \times 100}{\text{Weight after first cycle}}$$

This results in a number between 0 to 100. Shales with an $Id(2)$ less than 80 are considered soil-like and the plasticity index is determined. Shales with an $Id(2)$ greater than 80 are considered rock-like and a point load test is performed.

Franklin developed a rating chart using index of durability versus plasticity index or point load test. Figure 15 is the

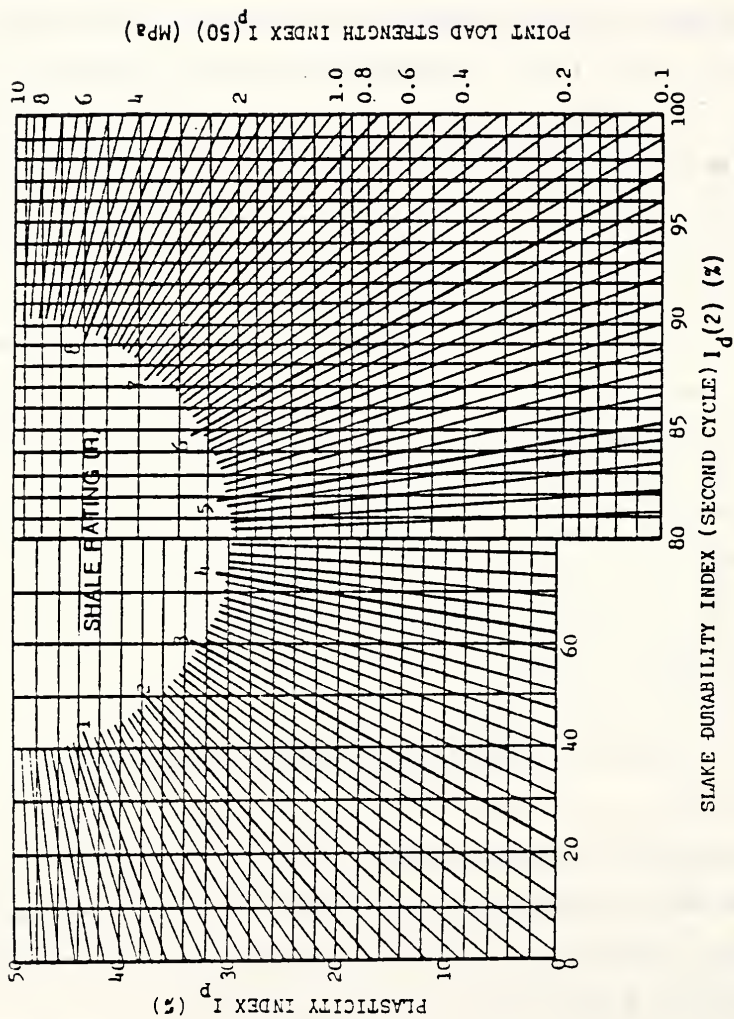


Figure 15. Franklin's Shale Rating Chart (32).

Franklin rating chart and is used to determine an 'R' value [32]. Figure 16a shows minimum lift thickness and compacted density verses the 'R' value. Figure 16b shows the correlation between the drained shear strength parameters and the 'R' value. These charts can be used to predict shale performance.

The Waldron Shale is considered a soil-like shale. It is broken down during compaction and is placed as a soil-like material. Most of the Ordovician-age shales are considered rock-like shales but in the long term would break down and be soil-like. If problems are expected with using a shale as a rock-type material, precautions can be taken to lessen degradation effects. Proper drainage within the fill helps to minimize slaking. Also, the shale fill should be isolated from water infiltration and from the environment. This can be accomplished by encasing the shale with a very low permeability fill material such as clay from the Wisconsinan ground moraine. These measures will help to slow down the slaking process and increase the service life of the fill.

SUMMARY

A summary of potential engineering soil problems of Decatur County is given in Table 9. Each parent material type is represented along with probability of certain problems occurring. These ratings reflect the average character of the parent material type.

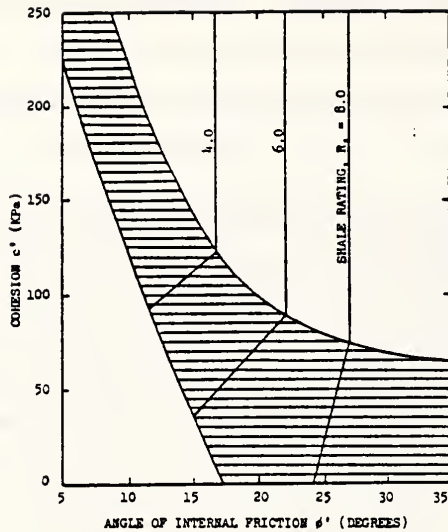


Figure 16a. Trends in Shear Strength Parameters of Compacted Shale Fills as a Function of the Shale Quality (32).

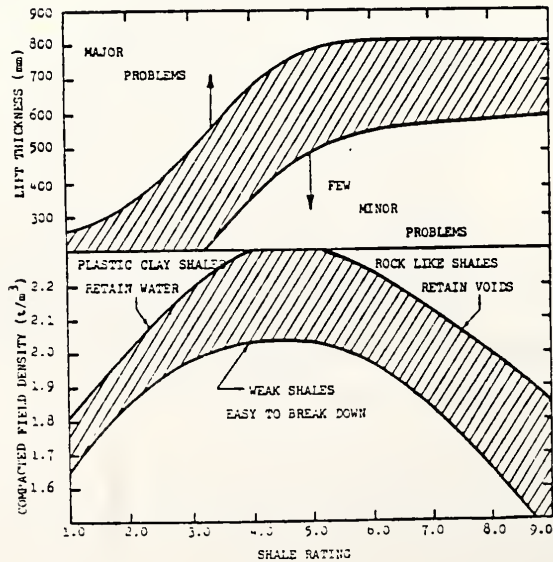


Figure 16b. Tentative Correlations Between Shale Quality, Lift Thickness, and Compacted Densities (32).

Table 9. Summary of Engineering Problems of Decatur County.

SYMBOL EXPLANATION	CUT DESIGN				EMBANKMENT FILL				EMBANKMENT FOUNDATION				HIGHWAY SUBGRADE				FOUNDATION DESIGN				MISCELLANEOUS			
	STABILITY				COMPACTED PROPERTIES				SETTLEMENTS				SUBGRADE SUPPORT				SHALLOW FOUNDATIONS				SHALLOW RESIDENTIAL SEPTIC SYSTEMS			
LIKELIHOOD OF A MAJOR PROBLEM DEVELOPING	GROUNDWATER CONTROL				EROSION				SURFACE DRAINAGE				NATURAL SLOPE AND RIVER BANK STABILITY				EROSION				BEARING CAPACITY			
	PERMEABILITY				RELATIVE PERMEABILITY				SHEAR STRENGTH				COMPRESSIBILITY WHEN SATURATED				NEGATIVE SKIN FRICTION				STEEL CORROSION			
PERMEABILITY	GENERAL SOIL TEXTURE				EROSION				NATURAL SLOPE AND RIVER BANK STABILITY				COMPRESSIBILITY WHEN SATURATED				NEGATIVE SKIN FRICTION				STEEL CORROSION			
	LAND FORM				EROSION				NATURAL SLOPE AND RIVER BANK STABILITY				COMPRESSIBILITY WHEN SATURATED				NEGATIVE SKIN FRICTION				STEEL CORROSION			
1 - LOW	Wisconsinan Ground	Silt, Clay and	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
2 - MEDIUM	Moraine	Sand	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
3 - HIGH	Wisconsinan Ridge	Silt, Sand and	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Moraine	Gravel	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Illinoian Ground	Silt, Sand and	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Moraine	Clay	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Thin Ill. over	Silt and Clay	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Limestone & Shale		1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Thin Ill. over	Silt and Clay	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Limestone	Sand, Silt and	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Terraces	Gravel	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Eskers & Kames	Sand, Silt and	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Gravel		1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Flood Plains in	Silt, Sand, Gravel	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Ill. Grd. Moraine	and slight Clay	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Flood Plains in	Silt, Sand, Gravel	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Misc. Grd. Moraine	and slight Clay	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Limestone Bench	Rock	1	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

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Appendix A.

Statistical Stream Flow Data (8).

WHITWATER RIVER AT BROOKVILLE, IND. (Continued)

LOWEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

YEAR	1	3	7	14	30	60	90	120	183	ANNUAL
1931	88.00 6	93.70 6	95.40 6	98.10 6	101.00 7	115.00 6	136.00 7	136.00 7	141.00 7	300.00 2
1932	93.00 10	95.30 9	100.00 10	119.00 14	194.00 28	272.00 32	312.00 28	316.00 27	334.00 19	1080.00 19
1933	119.00 21	124.60 21	136.00 22	146.00 22	162.00 23	254.00 30	366.00 35	423.00 35	579.00 36	1550.00 32
1934	184.00 32	181.00 31	196.00 32	213.00 34	216.00 32	252.00 39	336.00 33	306.00 26	346.00 20	1130.00 22
1935	60.00 1	65.00 2	69.10 2	70.40 2	84.90 1	91.60 1	92.90 1	99.90 1	111.00 1	212.00 1
1936	99.00 12	101.00 12	105.00 12	111.00 12	106.00 10	202.00 21	240.00 22	292.00 24	366.00 23	893.00 13
1937	73.00 3	75.70 3	87.60 4	86.00 4	95.80 3	121.00 6	162.00 13	226.00 19	406.00 30	1670.00 34
1938	130.00 24	195.00 36	216.00 36	263.00 40	401.00 39	500.00 39	532.00 39	573.00 38	899.00 37	1440.00 27
1939	216.00 38	215.00 37	215.00 37	219.00 35	219.00 35	274.00 32	348.00 32	348.00 32	568.00 35	1470.00 28
1940	121.00 22	126.00 22	130.00 21	136.00 21	139.00 16	164.00 17	176.00 10	175.00 12	266.00 13	952.00 15
1941	76.00 4	79.70 4	86.60 3	87.10 4	89.60 2	97.90 2	108.00 2	121.00 4	162.00 6	661.00 4
1942	64.00 2	64.70 1	86.00 1	71.50 1	132.00 15	148.00 15	162.00 14	167.00 18	246.00 14	753.00 5
1943	146.00 25	142.00 25	145.00 24	149.00 24	155.00 21	186.00 29	323.00 30	349.00 31	442.00 27	1170.00 24
1944	126.00 23	141.00 23	148.00 25	150.00 25	159.00 22	175.00 18	174.00 17	195.00 14	210.00 10	851.00 12
1945	86.00 5	86.30 5	89.00 5	97.10 6	97.70 6	103.00 3	111.00 3	116.00 3	127.00 2	1060.00 20
1946	156.00 26	161.00 27	166.00 28	181.00 29	211.00 30	285.00 36	403.00 36	590.00 39	850.00 38	1500.00 30
1947	118.00 18	117.00 10	120.00 17	123.00 15	126.00 12	136.00 12	151.00 12	183.00 13	286.00 15	796.00 9
1948	206.00 38	216.00 40	224.00 40	236.00 38	259.00 37	281.00 35	301.00 27	336.00 29	577.00 33	1610.00 36
1949	110.00 15	117.00 19	120.00 18	125.00 16	134.00 16	146.00 14	164.00 15	230.00 17	364.00 21	2080.00 38
1950	176.00 31	187.00 32	204.00 34	256.00 39	282.00 38	375.00 38	408.00 37	410.00 34	530.00 31	2050.00 37
1951	290.00 41	291.00 41	313.00 41	331.00 41	406.00 40	553.00 40	776.00 42	836.00 41	978.00 39	2160.00 40
1952	132.00 24	141.00 24	144.00 23	147.00 22	150.00 20	162.00 16	173.00 16	217.00 15	433.00 25	1670.00 35
1953	113.00 16	113.00 15	117.00 15	126.00 16	136.00 17	144.00 13	149.00 11	166.00 11	236.00 12	687.00 10
1954	101.00 13	102.00 13	105.00 13	110.00 11	114.00 9	117.00 7	120.00 6	127.00 6	156.00 5	530.00 3
1955	90.00 7	92.00 8	92.00 8	93.10 5	98.50 5	136.00 10	144.00 10	151.00 9	176.00 7	761.00 8
1956	91.00 8	96.70 10	99.10 9	103.00 9	131.00 14	216.00 23	327.00 32	405.00 33	539.00 32	1230.00 25
1957	116.00 19	116.00 18	117.00 14	118.00 13	123.00 11	129.00 9	142.00 9	156.00 10	234.00 11	779.00 7
1958	162.00 29	162.00 28	164.00 28	171.00 26	201.00 27	223.00 26	230.00 26	282.00 22	762.00 28	1510.00 31
1959	40.00 42	41.00 42	42.10 42	44.00 42	48.00 42	567.00 41	680.00 40	720.00 40	1356.00 41	2508.00 42
1960	156.00 27	159.00 26	174.00 29	179.00 28	192.00 25	217.00 25	240.00 21	254.00 20	312.00 17	607.00 11
1961	116.00 20	119.00 20	120.00 16	125.00 17	128.00 13	131.00 11	141.00 6	146.00 8	184.00 9	890.00 14
1962	211.00 40	212.00 39	217.00 38	220.00 36	239.00 36	274.00 34	322.00 29	354.00 30	479.00 29	1660.00 33
1963	206.00 36	209.00 37	216.00 39	221.00 37	229.00 35	261.00 31	281.00 25	266.00 21	294.00 16	972.00 16
1964	92.00 9	92.00 7	94.70 7	97.40 7	101.00 6	104.00 4	113.00 4	113.00 4	144.00 3	759.00 6
1965	96.00 11	99.30 11	101.00 11	103.00 10	106.00 8	112.00 5	118.00 5	128.00 5	161.00 8	1008.00 17

HIGHEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPTEMBER 30

YEAR	1	3	7	15	30	60	90	120	183	ANNUAL
1916	3670.00 29	2510.00 8	1430.00 9	849.00 9	639.00 8	495.00 8	393.00 9	349.00 8	287.00 6	1710.00 11
1917	1940.00 29	1450.00 25	827.00 25	521.00 29	396.00 27	280.00 30	236.00 31	209.00 31	169.00 25	1160.00 29
1924	2490.00 27	1180.00 27	671.00 26	459.00 32	357.00 28	267.00 28	207.00 32	186.00 37	149.00 32	880.00 12
1925	1420.00 42	329.00 42	297.00 40	220.00 40	159.00 40	111.00 40	92.00 40	87.30 40	73.70 40	555.00 39
1926	1450.00 33	1000.00 31	814.00 28	602.00 23	447.00 22	332.00 23	263.00 29	226.00 28	219.00 18	1916.00 6
1927	2290.00 23	1470.00 24	855.00 24	576.00 25	492.00 19	359.00 19	301.00 13	210.00 14	160.00 13	1770.00 10
1928	2840.00 17	1210.00 28	721.00 29	547.00 27	380.00 31	253.00 32	269.00 27	234.00 26	207.00 23	1440.00 16
1929	4600.00 4	2170.00 12	1110.00 16	716.00 14	451.00 20	380.00 18	353.00 14	326.00 12	327.00 5	1850.00 7
1930	2850.00 16	2650.00 5	2000.00 1	1260.00 3	774.00 3	499.00 4	417.00 6	355.00 10	252.00 14	1380.00 18
1931	6080.00 41	4020.00 41	2700.00 42	2140.00 41	1480.00 41	1080.00 41	857.00 41	734.00 42	614.00 41	3997.00 41
1932	2140.00 26	860.00 34	630.00 30	550.00 28	396.00 28	312.00 28	247.00 30	231.00 27	178.00 27	1140.00 26
1933	3450.00 10	2210.00 9	1340.00 10	799.00 11	571.00 12	524.00 9	439.00 9	394.00 9	348.00 9	2070.00 2
1934	7690.00 40	4380.00 40	2760.00 41	1710.00 42	1250.00 43	993.00 42	755.00 43	755.00 41	607.00 42	398.00 42
1935	1260.00 35	876.00 37	506.00 36	353.00 37	219.00 39	142.00 39	118.00 39	101.00 39	91.60 39	665.00 40
1936	1120.00 37	945.00 33	588.00 34	381.00 35	259.00 36	249.00 35	205.00 36	168.00 36	129.00 37	785.00 37
1937	4180.00 5	2540.00 5	1850.00 6	1570.00 6	1061.00 6	863.00 6	673.00 6	568.00 6	479.00 6	1810.00 9
1938	2000.00 28	1520.00 22	960.00 22	632.00 20	417.00 9	354.00 11	351.00 15	317.00 15	268.00 11	1820.00 8
1939	2730.00 19	1710.00 19	1010.00 20	603.00 22	390.00 28	348.00 21	320.00 19	263.00 19	211.00 20	1290.00 22
1940	2520.00 22	1600.00 15	1050.00 18	597.00 24	350.00 32	228.00 36	211.00 35	182.00 35	139.00 35	773.00 30
1941	2500.00 44	1710.00 44	1290.00 44	1020.00 44	671.00 44	452.00 44	381.00 44	363.00 44	372.00 44	271.00 44
1942	1780.00 31	1130.00 36	871.00 31	602.00 31	497.00 34	350.00 33	226.00 33	194.00 33	155.00 32	1010.00 29
1943	3060.00 11	2180.00 11	1620.00 3	877.00 7	496.00 16	317.00 25	226.00 23	249.00 22	209.00 21	1310.00 20
1944	2170.00 25	1800.00 16	1200.00 12	864.00 17	594.00 22	396.00 22	298.00 20	219.00 20	152.00 23	846.00 34
1945	2740.00 18	1640.00 20	1020.00 19	824.00 21	506.00 15	414.00 15	322.00 17	306.00 16	230.00 17	1290.00 21
1946	1440.00 34	772.00 35	501.00 30	330.00 38	245.00 34	259.00 34	229.00 32	201.00 32	176.00 28	1130.00 27
1947	2990.00 13	1900.00 13	1130.00 15	701.00 15	580.00 13	493.00 9	394.00 8	328.00 13	265.00 12	1600.00 13
1948	2670.00 20	1360.00 26	860.00 23	657.00 19	590.00 11	395.00 17	339.00 18	275.00 18	209.00 22	1190.00 23
1949	3140.00 3	3100.00 2	1570.00 2	964.00 5	671.00 3	596.00 3	498.00 2	427.00 2	330.00 4	1950.00 3
1950	3789.00 8	2610.00 8	1590.00 5	1380.00 2	965.00 2	783.00 1	609.00 1	530.00 1	398.00 1	2360.00 1
1951	2940.00 14	1720.00 18	997.00 21	746.00 13	480.00 18	420.00 14	379.00 11	368.00 6	331.00 3	1950.00 5
1952	4080.00 6	2730.00 4	1450.00 8	980.00 4	595.00 10	435.00 13	377.00 12	347.00 9	282.00 8	1560.00 14
1953	924.00 38	855.00 39	502.00 37	361.00 36	226.00 37	160.00 37	170.00 37	152.00 37	139.00 36	827.00 35
1954	3340.00 43	2930.00 43	2020.00 43	1480.00 43	140.00 42	99.00 43	80.00 42	70.00 43	58.00 43	35.00 43
1955	6040.00 39	4760.00 38	3530.00 35	437.00 34	340.00 33	255.00 31	213.00 34	187.00 34	145.00 34	875.00 33
1956	2280.00 24	1480.00 23	795.00 27	513.00 30	382.00 29	325.00 24	279.00 24	245.00 24	212.00 19	1410.00 17
1957	2880.00 15	1780.00 17	1140.00 14	691.00 18	423.00 24	349.00 20	291.00 21	259.00 20	208.00 24	1170.00 24
1958	2500.00 21	1520.00 21	1270.00 11	701.00 12	510.00 14	499.00 5	410.00 7	369.00 4	284.00 3	2010.00 3
1959	5500.00 1	3340.00 1	1610.00 4	870.00 8	740.00 5	497.00 9	385.00 10	320.00 11	250.00 16	1480.00 15
1960	1570.00 32	740.00 36	490.00 39	309.00 39	219.00 38	154.00 38	137.00 38	123.00 38	124.00 38	805.00 38
1961	3030.00 12	1800.00 14	1070.00 17	827.00 10	623.00 8	458.00 10	420.00 5	351.00 7	251.00 15	1370.00 19
1962	1260.00 18	1350.00 17	740.00 26	534.00 28	443.00 23	328.00 28	275.00 25	234.00 25	188.00 25	1140.00 25
1963	5200.00 2	3670.00 3	1510.00 7	914.00 8	639.00 7	416.00 18	313.00 20	248.00 23	178.00 29	1100.00 30
1964	3540.00 9	2200.00 10	1190.00 13	880.00 16	472.00 19	420.00 16	372.00 17	320.00 18	270.00 19	1540.00 18
1965	1200.00 36	905.00 32	603.00 33	399.00 38	274.00 30	205.00 29	173.00 28	122.00 29	109.00 32	730.00 32

WHITFATER RIVER AT HOOKVILLE, IND. (CONTINUED)

STATISTICS ON NORMAL MONTHLY MEANS (ALL DAYS)

OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT
BY HOWS (MEAN, VARIANCE, STANDARD DEVIATION, SKEWNESS, COEFF. OF VARIATION, PERCENTAGE OF AVERAGE FLOW)											
0.3880F+03	0.8659F+03	0.1040E+04	0.2220F+04	0.2007F+04	0.2373F+04	0.2205F+04	0.1430E+04	0.1192E+04	0.6866E+03	0.4266E+03	0.4334E+03
0.2137E+06	0.5769E+06	0.4092E+06	0.6332E+07	0.1740F+07	0.1784F+07	0.1487E+07	0.1091F+07	0.1104E+07	0.4459E+06	0.2649E+06	0.4241E+06
0.4623F+03	0.7595E+03	0.4533E+03	0.2514E+04	0.1319E+04	0.1330F+04	0.1219F+04	0.1045E+04	0.1051E+04	0.6677E+03	0.3196E+03	0.6512E+03
0.3683F+01	0.2137F+01	0.1221E+01	0.1844F+01	0.1671E+01	0.5197E+00	0.1270E+00	0.1561E+01	0.1693E+01	0.3133E+01	0.3861E+01	0.5004E+01
0.1191F+01	0.1141E+01	0.3149E+00	0.1134E+01	0.4571E+00	0.5802F+00	0.3530E+00	0.7269E+00	0.4881E+00	0.3728E+00	0.1218E+01	0.1502E+01
0.2574E+01	0.4447E+01	0.6499E+01	0.1472E+02	0.1332E+02	0.1574E+02	0.1462E+02	0.9539E+01	0.7906E+01	0.4553E+01	0.2830E+01	0.2875E+01

STATISTICS ON NORMAL ANNUAL MEANS (ALL DAYS)

MEAN	VARIANCE	STANDARD DEVIATION	SKEWNESS	COEFF. OF VARIATION	SERIAL CORR
0.1252E+04	0.2724E+06	0.5220E+03	-0.1454F+01	0.4168E+00	0.2616E+00

STATISTICS ON LOG MONTHLY MEANS (ALL DAYS)

OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT
BY HOWS (MEAN, VARIANCE, STANDARD DEVIATION, SKEWNESS, COEFF. OF VARIATION, PERCENTAGE OF AVERAGE FLOW)											
0.2629F+01	0.2614F+01	0.2429F+01	0.3074F+01	0.3146F+01	0.3249F+01	0.3283E+01	0.3055E+01	0.2934E+01	0.2710E+01	0.2495E+01	0.2442E+01
0.1167F+00	0.1467F+00	0.1243F+00	0.2454F+00	0.1806E+00	0.4447F+00	0.2407F+00	0.2435F+00	0.1194E+00	0.1044E+00	0.2716E+00	0.1153E+00
0.3416F+00	0.4107F+00	0.4441E+00	0.5157F+00	0.4008E+00	0.2908F+00	0.2400F+00	0.3077E+00	0.3461E+00	0.3230E+00	0.2452E+00	0.3396E+00
0.4024F+00	0.5120F+00	0.4163F+00	0.4124F+00	0.1079E+01	0.4762E+00	0.7023E+00	0.1725E+00	0.1872E+00	0.2491E+00	0.1376E+00	0.1076E+00
0.1407F+00	0.1366F+00	0.1346E+00	0.1417F+00	0.1268E+00	0.4862E+00	0.4847E+00	0.1006E+00	0.1178E+00	0.1194E+00	0.1143E+00	0.1379E+00
0.7074F+01	0.7424F+01	0.7221F+01	0.4454E+01	0.4230F+01	0.4597E+01	0.4303E+01	0.4401E+01	0.4541E+01	0.7493E+01	0.7274E+01	0.7171E+01

STATISTICS ON LOG ANNUAL MEANS (ALL DAYS)

MEAN	VARIANCE	STANDARD DEVIATION	SKEWNESS	COEFF. OF VARIATION	SERIAL CORR
0.3050E+01	0.5029E+01	0.2243E+00	-0.1034E+01	0.7353E+01	0.2273E+00

ANNUAL PEAKS

1918	40100	1939	23400	1957	35200
1917	28200	1938	20400	1956	28800
1916	17100	1940	26100	1959	81800
1915	35700	1941	3030	1960	20400
1920	45700	1942	20400	1961	42000
1924	25500	1943	52000	1962	26500
1925	8250	1944	28800	1963	64500
1926	21600	1945	28800	1964	46000
1927	28200	1946	21100	1965	22800
1928	28400	1947	39800	1966	12800
1929	69200	1948	37800	1967	23400
1930	30700	1949	81200	1968	57800
1931	11600	1950	45200	1969	31400
1932	24700	1951	32800	1970	27900
1933	39900	1952	61200	1971	29000
1934	13200	1953	13500	1972	17600
1935	18200	1954	4680	1973	17500
1936	17000	1955	12100		
1937	92200	1956	25000		

Appendix A-1 (Cont.)

WABASH RIVER BASIN

03365000 Sand Creek near Brewersville, Ind.

LOCATION.--Lat 39°05'03", long 85°39'32", in NW¼ sec. S, T.7 N., R.8 E., Jennings County, on left bank at downstream side of county highway bridge, 2.5 miles (4.0 km) west of Brewersville, 5.7 miles (9.2 km) upstream from Wyalosong Creek, and 16 miles (26 km) upstream from mouth.

DRAINAGE AREA.--155 mi² (401 km²).

DURATION TABLE OF DAILY DISCHARGE FOR YEAR ENDING SEPTEMBER 30

CLASS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34		
YEAR	NUMBER OF DAYS IN CLASS																																				CFS-DAYS
1944	21								1	1	9	3	2	10	6	13	17	12	16	13	16	11	8	7	3	2	2	1			1	1				15468.1	
1949	18										1	3	1	12	16	12	23	35	24	16	30	33	44	30	28	12	4	5	4	6	1	1				98133.3	
1950																	6	16	42	26	23	33	31	54	32	32	22	10	11	16	5	6	1	1		90185.2	
1951												1	25	10	11	15	6	25	23	12	8	23	48	51	26	21	27	9	11	7	3	1	1			81745.9	
1952												4	26	20	15	9	16	15	12	11	15	22	25	37	41	20	18	24	14	9	10	2	2	1	1	39530.8	
1953	22											2	5	7	10	14	20	11	12	19	10	20	13	29	16	31	35	41	17	14	6	6	3	1		5714.3	
1954	116											2	4	2	6	10	6	4	17	46	15	13	27	24	34	19	7	3	2	1					37788.4		
1955	29											3	1	1																						61089.4	
1956												2	1	6	5	12	11	8	26	48	59	44	24	36	26	23	14	9	4	3	3	2			65547.7		
1957												1	5	3	16	11	18	22	15	17	12	26	40	31	47	42	13	12	8	8	4	3	1	2	59601.5		
1958												9	4	2	1	6	7	7	2	18	19	32	56	54	35	31	37	8	12	9	5	5	3	1	2	63555.4	
1959												2	4	15	9	15	18	29	30	50	41	36	37	33	18	15	4	4	2	1				1	49545.1		
1960																	14	13	3	12	34	39	49	57	40	41	29	16	6	6	1	3	2			62797.2	
1961												4	6	11	67	46	10	56	26	20	16	17	23	13	15	8	8	9	4	2	3	1				50293.8	
1962													12	21	21	30	40	35	30	43	37	40	16	14	10	4	3	6	1	2					41446.1		
1963													3	10	8	14	35	75	53	39	29	22	25	20	9	5	6	3	2				1		46320.4		
1964	16												20	5	10	21	17	27	26	21	24	25	16	19	24	15	13	20	13	9	5	5	6	2	2	39476.6	
1965	40												1	6	26	18	22	43	22	22	24	23	28	35	12	12	16	6	6	2	1					38150.7	
1966													1	8	9	13	23	43	55	36	39	29	36	17	12	11	12	6	2	4	1				57458.1		
1967													2	2	7	11	24	20	25	39	33	32	12	13	12	14	4	4	1						70778.4		
1968													4	3	1	1	1	2	4	21	12	26	35	44	27	31	22	21	15	13	9	5	2		1	61362.1	
1969																	22	23	17	17	14	35	34	34	32	33	21	23	12	6	1	2	1			50935.4	
1970													2	12	33	21	20	23	21	23	27	31	30	28	30	22	18	8	7	3	1	2	2				36552.0
1971													2	3	2	2	2	5	20	20	20	45	44	53	36	24	28	22	15	12	4	5	1			59573.4	
1972													3	12	14	12	11	38	25	24	39	39	52	35	23	19	6	4	6	4	1					89150.6	
1973														10	14	18	20	17	9	10	33	35	52	38	35	33	18	13	8	2							

CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT
0	0.00	266	9314	100.0	9	0.44	61	6901	26.3	19	19.0	731	8634	63.7	27	860	150	358	3.6					
1	0.01	2	9046	97.1	10	0.60	94	9900	95.6	19	29.0	789	5203	55.9	28	1200	103	208	2.2					
2	0.02	1	9044	97.1	11	1.00	151	8402	94.5	20	44.0	827	4414	47.4	29	2000	55	105	1.1					
3	0.03	0	9043	97.1	12	1.50	200	8651	92.9	21	67.0	819	3587	38.5	30	3100	30	50	.5					
4	0.04	4	9043	97.1	13	2.20	322	8451	90.7	22	100.0	690	2768	29.7	31	4700	12	20	.2					
5	0.07	3	9039	97.0	14	3.40	505	8129	87.3	23	160.0	545	1878	20.2	32	7300	6	8						
6	0.10	37	9036	97.0	15	5.70	425	7624	81.9	24	240.0	457	1333	14.3	33									
7	0.20	22	8999	96.6	16	4.00	444	7199	77.3	25	370.0	325	876	9.4	34									
8	0.30	16	8977	96.4	17	12.00	771	6705	72.0	26	560.0	193	551	5.9										

LOWEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

YEAR	1	3	7	14	30	60	90	120	183	ANNUAL
1949	0.00 1	0.00 1	0.00 1	0.00 1	0.00 1	0.26 3	2.50 7	12.80 12	20.10 12	270.00 22
1950	2.60 21	3.30 22	3.70 23	4.60 23	9.30 22	23.60 23	60.90 23	67.50 23	78.60 22	300.00 24
1951	7.00 24	7.90 24	9.20 24	14.20 24	30.70 25	74.10 25	127.00 25	126.00 25	142.00 24	305.00 25
1952	0.51 11	0.50 11	0.50 10	0.61 10	0.76 7	1.80 7	1.90 4	7.90 9	28.10 15	216.00 16
1953	0.40 10	0.40 10	0.40 7	0.57 9	1.10 8	2.20 8	4.30 9	6.20 7	14.70 7	119.00 9
1954	0.00 2	0.00 2	0.00 2	0.00 2	0.00 2	0.60 1	0.60 1	0.45 1	2.70 2	50.00 1
1955	0.00 3	0.00 3	0.00 3	0.00 3	0.00 3	0.54 4	1.40 3	1.60 3	2.10 1	94.00 4
1956	0.00 4	0.00 4	0.00 4	0.00 4	0.00 4	9.20 17	18.40 21	26.00 19	35.10 16	116.00 7
1957	0.60 12	0.77 12	1.20 13	1.70 13	2.30 11	3.40 9	15.40 19	15.50 17	35.50 17	123.00 11
1958	0.30 7	0.37 8	0.41 4	0.56 7	2.00 10	4.40 12	5.40 11	10.10 10	92.20 23	221.00 19
1959	11.00 25	12.00 25	13.10 25	16.20 25	26.60 24	67.40 24	68.60 24	64.10 24	150.00 25	291.00 23
1960	1.10 14	1.30 14	1.70 15	2.30 15	6.20 19	11.10 20	13.10 16	14.70 14	18.40 11	89.00 3
1961	2.20 18	2.20 18	2.30 17	2.60 16	3.10 13	4.20 11	4.50 10	7.20 8	16.40 8	165.00 16
1962	1.30 15	1.30 15	1.40 14	1.80 14	6.60 21	10.60 19	13.20 18	15.40 16	17.80 10	182.00 17
1963	2.40 19	2.50 19	2.60 18	3.30 19	5.40 18	10.10 18	13.10 17	14.60 13	21.20 13	116.00 8
1964	0.30 8	0.33 7	0.44 9	0.57 8	0.68 6	1.60 6	2.30 6	2.70 4	12.50 6	120.00 10
1965	0.00 5	0.00 5	0.00 5	0.00 5	0.00 5	0.03 2	0.10 2	0.78 2	4.00 3	100.00 5
1966	1.90 16	2.00 16	2.60 19	3.20 17	6.30 20	12.20 21	12.40 15	15.00 15	17.60 9	88.00 2
1967	0.90 13	1.00 13	1.10 12	1.40 12	4.00 17	5.00 13	9.00 13	10.70 11	22.30 14	140.00 15
1968	0.00 6	0.00 6	0.01 6	0.04 6	0.15 5	0.88 5	2.20 5	3.90 5	11.60 5	139.00 14
1969	2.60 22	3.00 21	3.10 21	3.70 21	3.90 18	5.10 14	8.10 12	35.60 21	69.20 20	229.00 20
1970	2.60 20	2.70 20	3.00 20	3.30 18	3.50 14	7.90 16	9.00 14	25.00 18	40.60 18	133.00 12
1971	0.35 9	0.39 9	0.59 11	1.20 11	1.50 9	3.50 10	3.50 8	4.30 6	8.60 4	136.00 13
1972	3.10 23	3.40 23	3.60 22	4.40 22	13.40 23	23.00 22	39.80 22	43.10 22	48.50 19	111.00 6
1973	1.90 17	2.00 17	2.20 16	3.40 20	3.70 15	6.50 15	17.00 20	26.70 20	69.70 21	236.00 21

SAND CREEK NEAR BREWERSVILLE, IND. (Continued)

HIGHEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPTEMBER 30

YEAR	1	3	7	15	30	60	90	120	183	ANNUAL								
1949	8930.0	5	5730.0	4	2730.0	4	1400.0	4	1430.0	2	786.0	2	662.0	2	466.0	2	269.0	2
1950	10100.0	3	5820.0	3	3250.0	1	2340.0	1	1590.0	1	1230.0	1	948.0	1	812.0	1	600.0	1
1951	7350.0	7	3080.0	12	1790.0	9	1130.0	9	855.0	7	679.0	5	548.0	5	515.0	3	450.0	3
1952	5220.0	13	3490.0	7	1950.0	7	1310.0	7	814.0	8	605.0	7	577.0	4	510.0	4	417.0	4
1953	2350.0	22	1510.0	23	944.0	24	587.0	24	391.0	24	292.0	23	249.0	23	225.0	22	206.0	20
1954	385.0	25	241.0	25	191.0	25	109.0	25	72.0	25	65.0	25	57.0	25	49.4	25	35.4	25
1955	2719.0	21	1670.0	20	1220.0	17	857.0	18	641.0	16	439.0	16	327.0	20	272.0	20	194.0	22
1956	4680.0	14	2220.0	18	1190.0	21	630.0	22	546.0	19	417.0	19	384.0	16	342.0	14	269.0	14
1957	6180.0	10	3380.0	10	1870.0	8	1060.0	11	578.0	10	549.0	9	439.0	10	397.0	8	332.0	6
1958	3880.0	16	2620.0	14	1560.0	13	952.0	15	657.0	14	430.0	18	411.0	12	382.0	9	287.0	11
1959	13100.0	1	6510.0	1	2930.0	3	1540.0	3	1070.0	3	709.0	3	537.0	6	428.0	6	323.0	9
1960	7480.0	8	3440.0	8	1560.0	12	953.0	14	519.0	21	330.0	22	245.0	24	216.0	23	218.0	18
1961	8730.0	8	4650.0	6	2250.0	6	1420.0	6	981.0	5	625.0	6	639.0	3	495.0	5	332.0	7
1962	3570.0	17	2350.0	15	1410.0	15	878.0	17	647.0	15	433.0	17	371.0	17	310.0	17	228.0	17
1963	5900.0	11	3080.0	11	1860.0	11	1100.0	10	808.0	9	494.0	13	359.0	18	288.0	19	206.0	19
1964	9360.0	4	4410.0	2	3230.0	2	1780.0	2	1010.0	4	690.0	4	477.0	7	374.0	10	250.0	16
1965	2800.0	20	1720.0	19	1220.0	16	651.0	21	500.0	22	336.0	21	334.0	19	294.0	18	204.0	21
1966	2100.0	24	1410.0	24	1010.0	23	629.0	23	459.0	23	271.0	24	253.0	22	230.0	21	182.0	23
1967	3280.0	16	1970.0	16	1210.0	19	924.0	16	665.0	13	440.0	15	403.0	14	347.0	13	293.0	10
1968	11100.0	2	4840.0	5	2770.0	5	1460.0	5	889.0	6	547.0	6	473.0	8	373.0	11	323.0	8
1969	5800.0	12	3300.0	9	1770.0	10	1210.0	8	785.0	10	531.0	12	408.0	13	334.0	15	277.0	13
1970	6840.0	9	2690.0	13	1420.0	14	784.0	19	702.0	12	542.0	11	427.0	11	306.0	12	268.0	15
1971	3080.0	19	1580.0	21	1210.0	20	768.0	20	520.0	20	355.0	20	281.0	21	213.0	24	165.0	24
1972	4130.0	15	2020.0	17	1200.0	18	1010.0	12	614.0	17	405.0	14	385.0	15	329.0	15	282.0	12
1973	2310.0	23	1510.0	22	1160.0	22	975.0	13	735.0	11	571.0	8	454.0	9	398.0	7	379.0	5

STATISTICS ON MONTHLY MEANS (ALL DAYS)

CCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT
BY ROWS (MEAN, VARIANCE, STANDARD DEVIATION, SKEWNESS, COEFF. OF VARIATION, PERCENTAGE OF AVERAGE FLOW)											
0.1855E+02	0.7232E+02	0.1778E+03	0.3324E+03	0.2838E+03	0.3632E+03	0.2799E+03	0.2094E+03	0.1069E+03	0.8806E+02	0.3250E+02	0.2646E+02
0.0840E+02	0.1223E+05	0.2492E+05	0.1642E+06	0.3919E+05	0.6273E+05	0.3185E+05	0.1250E+05	0.9724E+04	0.2450E+04	0.2426E+04	0.2426E+04
0.2840E+02	0.1100E+01	0.1814E+03	0.4052E+03	0.1980E+03	0.6229E+03	0.1789E+03	0.1110E+03	0.4880E+02	0.4950E+02	0.2079E+02	0.2079E+02
0.3632E+01	0.2458E+01	0.0872E+00	0.2004E+01	0.1624E+01	0.7881E+00	0.6570E+00	0.1450E+01	0.1520E+01	0.1307E+01	0.2319E+01	0.2411E+01
0.1531E+01	0.1525E+01	0.1422E+01	0.1219E+01	0.6070E+00	0.6695E+00	0.6375E+00	0.1003E+01	0.1027E+01	0.1112E+01	0.1525E+01	0.1794E+01
0.9495E+00	0.2623E+01	0.4885E+01	0.1045E+02	0.1422E+02	0.1820E+02	0.1402E+02	0.1019E+02	0.5545E+01	0.3441E+01	0.1620E+01	0.1427E+01

STATISTICS ON ANNUAL MEANS (ALL DAYS)

MEAN	VARIANCE	STANDARD DEVIATION	SKEWNESS	COEFF. OF VARIATION	SERIAL CORR
0.1639E+03	0.4498E+04	0.7064E+02	0.7343E+00	0.4258E+00	0.0110E+00

STATISTICS ON MONTHLY MEANS (ALL DAYS)

CCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT
BY ROWS (MEAN, VARIANCE, STANDARD DEVIATION, SKEWNESS, COEFF. OF VARIATION, PERCENTAGE OF AVERAGE FLOW)											
0.8548E+00	0.1410E+01	0.1518E+01	0.2294E+01	0.2312E+01	0.2436E+01	0.2342E+01	0.1822E+01	0.1805E+01	0.1810E+01	0.1103E+01	0.7962E+00
0.4447E+00	0.4447E+00	0.1180E+00	0.5553E+00	0.1753E+00	0.1383E+00	0.1117E+00	0.1803E+00	0.2386E+00	0.4449E+00	0.2915E+00	0.7537E+00
0.8548E+00	0.8548E+00	0.4447E+00	0.5553E+00	0.1753E+00	0.1383E+00	0.1117E+00	0.1803E+00	0.2386E+00	0.4449E+00	0.2915E+00	0.7537E+00
0.7186E+00	0.1266E+00	0.1266E+00	0.5739E+00	0.1119E+00	0.6638E+00	0.5786E+00	0.6610E+00	0.1694E+00	0.1243E+00	0.4403E+00	0.3206E+00
0.7816E+00	0.4816E+00	0.3373E+00	0.2224E+00	0.1811E+00	0.1935E+00	0.1428E+00	0.2034E+00	0.2746E+00	0.6293E+00	0.4403E+00	0.1119E+00
0.4086E+01	0.6734E+01	0.5116E+01	0.1072E+02	0.2199E+02	0.1110E+02	0.1113E+02	0.1109E+02	0.4580E+01	0.7852E+01	0.5534E+01	0.1788E+01

STATISTICS ON ANNUAL MEANS (ALL DAYS)

MEAN	VARIANCE	STANDARD DEVIATION	SKEWNESS	COEFF. OF VARIATION	SERIAL CORR
0.2171E+01	0.5766E+01	0.4405E+00	-0.2122E+01	0.1108E+00	0.4006E+00

ANNUAL PEARSON

1944	9980	1961	8540
1949	12100	1962	8400
1950	12400	1963	8400
1951	11100	1964	14000
1952	5780	1965	1400
1953	3460	1966	4020
1954	1240	1967	4000
1955	4200	1968	14000
1956	7560	1969	7400
1957	8400	1970	8400
1958	7140	1971	2000
1959	19400	1972	4000
1960	9750	1973	4020

MARAGH RIVER BASIN

03364500 Clifty Creek at Hartsville, Ind.

LOCATION.--Lat 39°16'25", long 85°42'10", in NW¼ sec.30, T.10 N., R.7 E., Bartholomew County, at downstream side of left abutment of highway bridge, 0.2 mile (0.3 km) north of Hartsville, and 5 miles (8 km) upstream from Duck Creek.

DRAINAGE AREA.--91.4 mi² (236.7 km²).

DURATION TABLE OF DAILY DISCHARGE FOR YEAR ENDING SEPTEMBER 30

CLASS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34		
YEAR	NUMBER OF DAYS IN CLASS																																				CFS-DAYS
1948	28					7	1	5	5	2	5	3	9	13	13	7	6	12	3	14	11	10	7	6	3	2	2										9246.5
1949	1					4	6	4	1			7	14	19	23	9	17	9	17	21	20	25	25	31	31	24	14	12	7	6			6	1	3	1	88537.8
1950												1	8	7	12	16	17	37	25	18	34	27	29	42	22	24	12	9	13		2	4	4	1	1	71959.1	
1951	12					2	6	5	9	4	4	2	4	4	7	15	31	21	23	26	30	28	37	21	26	21	8	7	3	2	3					54589.3	
1952	27					10	3	8	8	6	4	2	4	4	4	7	15	31	17	18	18	36	36	24	22	19	10	3	5	1				2		49930.6	
1953	46					5	19	10	6	4	8	10	7	9	7	8	6	14	20	15	42	32	18	27	14	10	12	4	2							23456.3	
1954	141					1	1	2		1	2	2	2	4	14	20	17	28	23	15	17	11	3	1												3284.3	
1955	110					1				1	4	3	1	2	1	5	13	15	24	22	33	34	28	12	9	10	5	1	1								23740.5
1956	3					2	3	1	5	4	1	4	4	10	8	7	9	24	34	36	47	30	37	38	15	6	2	4	2	2	3					41919.9	
1957	5					5	4	5	3	10	16	19	18	14	12	5	4	6	29	29	33	43	31	32	12	11	6	7	1	1	2			1		35130.4	
1958						3	5	5		4	7	8	11	1	1	3	5	25	48	49	37	33	45	29	15	17	3	4	5	1					1	44444.0	
1959	5					1	3	1	5	2	16	13	7	12	16	10	14	27	30	25	42	36	25	35	22	9	2	2			2	1	1		1	33036.6	
1960																7	20	11	10	17	22	40	50	30	39	35	27	28	17	4	3	2	2			23580.2	
1961	3					2	2	1	14	3	6	28	17	24	39	28	29	14	11	22	16	18	15	12	15	16	11	10	4	2	1	1	1			36844.9	
1962																7	6	8	5	35	33	15	17	27	19	31	30	19	26	16	9	7	2	3	2	29117.2	
1963	8					2	1	1	1	6	7	9	10	15	23	26	26	22	44	33	24	19	17	19	10	8	4	3	2	1					1	24530.4	
1964	88					7	2	2	5	9	16	18	19	21	17	15	32	19	17	8	5	9	14	10	18	8	5	2	1						1	27119.8	
1965	65									3	1	3	22	17	15	9	20	19	20	18	20	15	28	18	20	14	14	10	5	1	3	1					27593.6
1966	13					6	3	1	2	3	3	6	9	16	10	24	37	33	21	45	43	32	14	16	14	10	1	2	2							17956.5	
1967	49	1				1	2	2		1	6	6	10	20	15	13	10	14	25	36	37	24	28	22	12	9	6	3	2	2						32757.1	
1968	32										1	4	11	5	8	7	8	17	45	40	27	26	24	31	30	17	9	5	7	3	2	1			1	46637.8	
1969																	2	5	6	17	26	8	19	23	39	61	44	22	24	30	10	10	3	3	2	3	3628.3
1970						1	6	6	2	4	7	11	13	8	23	17	27	9	17	37	27	38	25	25	17	11	3	3	1							1	27768.0
1971																																					18564.1
1972	42					3	8	1	2	4	2	6	9	5	13	34	36	21	33	50	34	28	21	12	19	10	4	3	3	1						28435.1	
1973							2	2	2	1	6	4	6	3	2	23	24	31	26	39	36	31	33	20	11	11	6	3	1							1	43597.4

CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT
0	0.00	718	3314	100.0	9	0.40	81	8299	69.1	18	16.0	644	5533	59.4	27	0.00	116	322	3.4
1	0.02	1	8506	92.3	10	0.40	155	8218	88.2	19	24.0	687	4869	52.5	28	0.00	860	456	2.2
2	0.04	0	8595	92.3	11	1.20	275	8063	86.6	20	34.0	817	4202	45.1	29	0.00	960	51	1.2
3	0.06	5	8595	92.3	12	1.80	241	7788	83.6	21	49.0	756	3385	36.3	30	1400	30	70	7
4	0.09	0	8590	92.2	13	2.50	342	7567	81.0	22	72.0	588	2629	28.2	31	2000	24	44	4
5	0.12	74	8590	92.2	14	3.70	353	7205	77.4	23	100.0	693	2641	21.9	32	2900	11	16	1
6	0.20	69	8516	91.4	15	5.30	387	6852	73.6	24	150.0	491	1344	14.5	33	4300	5	5	
7	0.30	80	8447	90.7	16	7.70	389	6465	69.4	25	270.0	316	857	9.2	34	6200			
8	0.40	88	8387	90.0	17	11.00	543	6076	65.2	26	320.0	219	541	5.8					

LOWEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

YEAR	1	3	7	14	30	60	90	120	183	ANNUAL
1948	0.00 1	0.00 1	0.00 1	0.00 1	0.01 7	0.77 9	1.40 10	15.60 19	17.20 14	182.00 24
1949	0.80 20	0.97 20	1.20 20	1.60 20	5.80 24	13.60 24	27.80 24	38.40 22	57.10 23	182.00 25
1951	1.80 24	1.90 23	2.20 23	3.00 24	5.30 23	11.10 22	24.50 22	42.50 24	55.20 22	184.00 23
1952	0.00 2	0.00 2	0.00 2	0.04 10	0.10 9	0.20 6	0.80 6	6.40 14	28.30 18	144.00 21
1953	0.00 3	0.00 3	0.00 3	0.09 11	0.19 10	0.72 8	1.10 7	1.20 5	7.80 8	65.90 8
1954	0.00 4	0.00 4	0.00 4	0.00 2	0.00 1	0.00 1	0.00 1	0.00 1	1.50 2	26.80 1
1955	0.00 5	0.00 5	0.00 5	0.00 3	0.00 2	0.00 2	0.00 2	0.00 2	0.04 1	44.80 2
1956	0.00 6	0.00 6	0.00 4	0.00 4	0.03 9	0.80 21	32.90 25	46.40 25	51.70 21	92.40 16
1957	0.00 7	0.00 7	0.13 15	0.27 15	0.55 11	1.30 11	2.10 12	2.80 8	15.00 12	74.30 10
1958	0.00 8	0.00 8	0.06 13	0.24 12	0.77 12	1.00 10	1.30 9	5.60 13	45.80 20	114.00 19
1959	7.70 25	9.20 25	11.50 25	13.10 25	15.10 25	21.60 25	26.90 23	39.00 23	66.70 24	156.00 22
1960	0.00 9	0.00 9	0.04 17	0.24 13	0.91 14	2.80 14	4.70 16	5.10 11	8.70 9	45.70 3
1961	0.51 19	0.50 19	0.50 17	0.84 17	1.10 15	1.60 12	2.00 11	2.80 9	6.50 7	82.70 15
1962	0.00 10	0.03 15	0.14 16	0.27 14	1.10 16	2.00 13	2.40 13	5.10 12	11.40 10	111.00 18
1963	1.20 23	2.10 24	2.80 24	2.40 23	4.10 22	6.20 19	8.00 19	9.10 16	14.50 11	65.30 7
1964	0.00 11	0.00 10	0.00 7	0.00 5	0.00 3	0.17 5	0.69 5	0.90 4	5.10 4	60.40 5
1965	0.00 12	0.00 11	0.00 4	0.00 6	0.00 4	0.00 3	0.00 3	0.00 3	1.40 3	73.90 9
1966	0.40 18	0.40 14	0.66 19	1.30 19	3.10 20	12.00 23	13.60 21	14.90 18	17.60 15	64.00 6
1967	0.00 13	0.00 12	0.00 9	0.01 9	2.20 17	3.10 18	3.40 14	6.90 15	16.10 13	77.50 12
1968	1.00 21	1.00 13	0.00 10	0.00 7	0.00 5	0.00 4	0.03 4	1.30 6	6.15 6	78.70 13
1969	1.00 21	1.70 21	1.70 21	1.90 21	2.20 21	5.40 17	6.40 18	29.20 21	78.40 25	142.00 20
1970	1.20 22	1.20 22	1.60 21	2.40 22	3.70 21	5.40 18	5.40 17	17.20 19	28.30 19	79.70 14
1971	0.06 16	0.07 16	0.09 14	0.28 15	0.80 13	2.90 15	4.00 15	4.10 10	5.80 5	75.60 11
1972	0.16 17	0.26 17	0.44 19	0.73 18	2.20 19	4.50 20	9.40 20	14.80 17	20.40 16	53.00 4
1973	0.00 15	0.00 14	0.00 11	0.00 8	0.00 6	0.32 7	1.10 8	2.80 7	25.80 17	105.00 17

WARASH RIVER BASIN

03361500 Flatrock River at St. Paul, Ind.

LOCATION:--Lat 39°25'03", long 85°38'03", in SEVEN sec.9, T.11 N., R.8 E., Shelby County, on right bank 500 ft (152 m) downstream from highway bridge, 0.8 mile (1.3 km) southwest of St. Paul, and 1.5 miles (2.4 km) downstream from Mill Creek.

DRAINAGE AREA:--303 mi² (785 km²).

REMARKS:--Slight diversion occasionally by quarry above gage.

DURATION TABLE OF DAILY DISCHARGE FOR YEAR ENDING SEPTEMBER 30

CLASS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
YEAR	NUMBER OF DAYS IN CLASS																																		CFS-DAYS
1931	3	1	2	2	3	5	6	2	10	12	10	45	60	55	40	24	25	19	11	10	6	4	7	1	2										2712.0
1932								5	4	9	10	16	36	28	29	15	24	21	38	28	19	29	16	15	11	6	4	3	2						102072.3
1933								3	11	10	9	20	22	13	9	8	23	36	45	31	41	22	15	9	7	5	3	3				2			107943.1
1934								2	5	7	9	14	14	14	9	8	16	6	17	49	64	23	18	23	26	15	5	6	3	2	2				30320.4
1935																																			47859.7
1936																																			91405.6
1937																																			208148.0
1938																																			210590.0
1939																																			130567.1
1940																																			71142.5
1941																																			14405.2
1942																																			104511.6
1943																																			114940.0
1944																																			75401.5
1945																																			122800.5
1946																																			113735.2
1947																																			160618.8
1948																																			105678.2
1949																																			189745.6
1950																																			234456.0
1951																																			187283.0
1952																																			148080.6
1953																																			72542.4
1954																																			27658.2
1955																																			71576.3
1956																																			132906.6
1957																																			105648.8
1958																																			175604.0
1959																																			126302.5
1960																																			81218.0
1961																																			139291.0
1962																																			93748.0
1963																																			74627.1
1964																																			40903.0
1965																																			89310.3
1966																																			51769.1
1967																																			125705.1
1968																																			148485.1
1969																																			155066.0
1970																																			91579.0
1971																																			88554.2
1972																																			89267.2
1973																																			178399.0

CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT
0	0.00	0	15706	100.0	9	6.80	330	15147	96.18	18	110.00	896	7956	50.7	27	160.00	215	509	3.2
1	0.50	5	15706	100.0	10	9.30	459	14817	94.3	19	140.00	1180	7060	45.0	28	220.00	119	294	1.8
2	0.80	20	15701	100.0	11	13.00	592	14358	91.4	20	190.00	1210	5880	37.4	29	300.00	78	175	1.1
3	1.10	28	15681	99.8	12	17.00	828	13766	87.6	21	260.00	1123	4667	29.7	30	410.00	50	97	.6
4	1.50	43	15653	99.7	13	23.00	1019	12038	82.4	22	360.00	935	3544	22.6	31	550.00	24	47	.2
5	2.00	79	15610	99.4	14	31.00	1004	11919	75.9	23	480.00	858	2609	16.6	32	750.00	13	23	.1
6	2.70	101	15531	98.9	15	42.00	910	10915	69.5	24	660.00	574	1751	11.1	33	1000.00	9	10	
7	3.70	93	15430	98.2	16	58.00	846	10805	83.7	25	890.00	383	1177	7.5	34	1400.00	1	1	
8	5.00	190	15337	97.7	17	78.00	1203	9159	58.3	26	1200.00	285	794	5.1					

LOWEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

YEAR	1	3	7	14	30	60	90	120	183	ANNUAL
1932	0.80 1	0.77 1	1.00 3	4.50 9	10.60 17	20.10 23	30.30 23	37.40 22	46.50 14	255.00 15
1933	5.50 15	6.10 15	7.00 16	7.90 16	14.30 23	35.50 32	116.00 40	133.00 37	145.00 35	399.00 30
1934	7.30 21	7.60 19	9.40 21	11.30 22	14.60 24	24.20 24	59.30 33	63.20 31	79.60 22	275.00 20
1935	1.00 4	1.10 4	1.20 4	1.80 3	2.30 2	4.50 3	6.30 3	8.00 3	11.00 1	39.40 1
1936	23.00 38	23.30 38	25.30 36	27.00 37	27.80 34	41.20 35	58.10 32	86.80 33	133.00 32	286.00 23
1937	1.30 5	1.30 5	1.60 5	2.10 4	3.20 5	6.90 6	15.30 12	27.70 17	127.00 30	505.00 40
1938	17.00 35	18.00 36	23.40 36	27.10 38	35.90 38	52.20 38	79.10 38	92.90 34	154.00 36	431.00 33
1939	15.00 33	16.30 34	17.90 33	19.50 32	26.40 29	42.80 26	64.80 29	86.20 26	140.00 34	486.00 37
1940	6.60 18	7.10 18	7.80 17	8.70 18	9.50 15	13.60 15	16.60 14	18.50 11	49.50 17	271.00 17
1941	1.30 6	1.60 7	2.20 8	3.20 8	3.30 8	4.50 4	6.30 4	9.90 5	17.60 5	131.00 3
1942	0.70 2	0.80 2	0.89 2	1.70 2	3.90 7	5.90 5	12.10 11	21.60 13	46.90 15	200.00 12
1943	14.00 32	15.70 32	20.40 35	21.60 34	22.30 30	30.40 28	74.00 35	76.40 32	125.00 29	321.00 26
1944	11.00 23	12.00 26	12.70 25	13.10 25	16.80 25	19.80 22	22.20 19	24.10 16	30.50 8	184.00 7
1945	5.80 16	5.10 16	6.40 14	8.60 13	7.40 11	8.30 10	8.90 6	10.10 6	12.70 2	27.00 16
1946	13.00 30	13.70 29	15.10 28	16.10 26	19.60 27	51.60 37	83.80 37	193.00 41	218.00 40	430.00 32
1947	7.90 19	7.80 20	7.90 18	8.20 17	8.80 14	11.70 13	15.70 13	22.80 15	52.50 19	195.00 10
1948	28.00 40	28.30 40	28.70 40	31.50 39	38.70 39	44.20 36	52.50 31	59.60 30	143.00 34	486.00 37
1949	7.60 18	6.10 18	7.60 19	11.70 19	18.80 19	31.10 18	47.10 17	57.00 16	87.50 14	270.00 11
1950	11.90 25	11.30 23	13.00 26	12.90 26	28.90 36	95.30 41	91.50 38	99.60 38	115.00 28	556.00 30

FLATROCK RIVER AT ST. PAUL, IND. (Continued)

LOWEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MARCH 31

YEAR	1	3	7	14	30	60	90	120	183	ANNUAL
1951	23.00 39	23.30 37	27.70 39	34.30 40	41.40 40	65.40 39	132.00 41	140.00 39	194.00 38	538.00 38
1952	11.00 25	11.00 24	11.40 24	12.00 23	12.60 19	13.90 16	16.90 15	26.90 18	104.00 27	458.00 35
1953	4.00 14	5.00 14	8.40 15	7.80 15	8.20 13	10.60 12	11.30 8	12.30 6	29.60 6	187.00 9
1954	2.00 9	2.10 9	2.20 9	2.20 8	2.40 3	3.20 1	4.70 1	7.30 2	12.90 3	109.00 2
1955	1.80 8	1.80 8	2.10 7	2.40 7	2.90 4	7.10 7	7.90 5	9.00 4	14.40 4	175.00 5
1956	1.40 7	1.50 6	1.80 6	2.10 5	4.50 8	18.60 20	36.30 34	94.50 35	137.00 33	315.00 25
1957	3.50 10	3.80 10	5.80 13	6.70 14	7.70 12	9.80 11	11.50 9	15.50 9	37.20 11	184.00 8
1958	14.00 31	15.00 31	15.70 31	16.50 31	22.40 31	31.40 29	38.30 26	56.50 27	204.00 39	392.00 28
1959	87.00 42	88.30 42	76.10 42	74.00 42	96.60 42	134.00 42	176.00 42	195.00 42	323.00 42	581.00 42
1960	6.30 17	6.90 17	8.30 20	5.60 20	13.40 22	18.40 19	24.50 20	33.10 19	50.20 18	199.00 11
1961	11.00 26	11.00 25	11.30 23	12.00 24	13.00 21	15.40 18	18.60 17	21.90 14	33.60 9	275.00 21
1962	17.00 38	17.70 35	19.30 34	20.60 33	26.70 33	32.20 30	37.30 25	46.70 25	80.10 23	413.00 31
1963	16.00 34	16.00 33	17.30 32	18.60 31	24.30 32	27.80 25	36.20 22	35.40 20	44.70 13	203.00 13
1964	0.80 3	0.80 3	0.80 1	0.87 1	1.30 1	2.40 2	5.90 2	6.90 1	16.80 6	154.00 4
1965	3.80 11	4.30 12	4.50 10	5.40 11	6.70 10	7.10 8	9.00 7	11.70 7	35.20 10	295.00 24
1966	12.00 27	13.30 27	15.30 29	18.20 27	16.90 26	36.50 34	40.60 27	56.90 28	87.50 21	214.00 14
1967	4.10 13	4.30 13	4.80 11	6.20 12	10.00 16	13.20 14	18.50 16	19.60 12	49.50 16	265.00 18
1968	4.00 12	4.20 11	4.60 12	5.20 10	5.60 9	7.90 9	11.80 10	17.60 10	39.10 12	274.00 19
1969	23.00 37	24.00 39	24.30 37	26.20 36	28.20 35	35.30 31	46.50 30	126.00 39	233.00 41	464.00 36
1970	47.00 41	47.70 41	49.90 41	57.60 41	71.60 41	78.60 40	92.20 39	159.00 40	188.00 37	353.00 27
1971	13.00 28	14.00 30	15.60 30	21.90 35	29.20 37	36.10 33	40.80 28	44.30 24	61.70 20	281.00 22
1972	13.00 29	13.70 28	15.10 27	17.20 29	19.80 28	29.60 27	32.40 24	35.70 21	61.60 25	182.00 6
1973	6.90 22	9.20 22	10.20 22	10.40 21	12.30 18	19.60 21	29.20 21	38.30 23	131.00 31	437.00 34

HIGHEST MEAN DISCHARGE, IN CFS, AND RANKING, FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPTEMBER 30

YEAR	1	3	7	15	30	60	90	120	183	ANNUAL
1931	1160.0 42	1000.0 42	678.0 41	514.0 41	347.0 42	258.0 42	198.0 42	160.0 42	117.0 42	74.0 42
1932	1300.0 29	2230.0 32	1640.0 30	1550.0 26	1110.0 24	888.0 21	791.0 25	579.0 26	430.0 29	279.0 24
1933	9620.0 8	5350.0 16	3070.0 15	1840.0 19	1210.0 20	1110.0 12	943.0 10	865.0 9	631.0 6	515.0 5
1934	1860.0 36	1520.0 38	1020.0 40	584.0 40	407.0 41	291.0 41	223.0 41	255.0 40	193.0 34	108.0 40
1935	1770.0 39	1440.0 39	1200.0 37	950.0 37	611.0 37	409.0 36	372.0 36	308.0 38	238.0 38	131.0 39
1936	3460.0 31	2860.0 29	1860.0 28	1320.0 29	877.0 30	663.0 22	493.0 27	508.0 24	451.0 26	250.0 27
1937	1340.0 3	947.0 2	690.0 1	535.0 1	351.0 1	212.0 2	150.0 2	128.0 2	97.0 2	51.0 3
1938	6540.0 19	5370.0 14	3510.0 11	2250.0 9	1940.0 4	1460.0 4	1130.0 5	1060.0 4	872.0 5	577.0 2
1939	8020.0 9	5370.0 15	3290.0 12	2050.0 12	1260.0 17	1060.0 13	952.0 9	784.0 12	621.0 13	358.0 15
1940	8900.0 17	5010.0 17	2980.0 17	1650.0 24	959.0 28	596.0 34	585.0 33	500.0 32	372.0 34	194.0 37
1941	886.0 43	537.0 43	326.0 43	200.0 43	156.0 43	103.0 43	84.3 43	74.6 43	65.4 43	40.6 43
1942	3690.0 28	3040.0 27	1860.0 29	1450.0 27	862.0 33	757.0 26	672.0 26	581.0 25	465.0 24	286.0 23
1943	7970.0 11	5550.0 11	4080.0 6	2260.0 10	1220.0 19	805.0 24	713.0 22	627.0 21	533.0 19	324.0 19
1944	7130.0 14	5510.0 12	3620.0 9	1880.0 13	1260.0 18	911.0 20	705.0 24	677.0 27	594.0 33	266.0 34
1945	5450.0 22	4470.0 20	2830.0 20	1690.0 21	1370.0 14	1120.0 10	864.0 14	808.0 11	604.0 14	336.0 18
1946	2390.0 34	1720.0 36	1400.0 33	1050.0 33	739.0 34	655.0 32	648.0 29	554.0 30	471.0 23	312.0 20
1947	6800.0 18	5490.0 13	3110.0 14	1890.0 16	1460.0 11	1130.0 6	1080.0 6	925.0 6	744.0 8	440.0 9
1948	5400.0 23	3700.0 25	2560.0 22	1870.0 17	1570.0 9	1020.0 15	849.0 15	690.0 15	521.0 21	289.0 21
1949	16500.0 1	10400.0 1	5350.0 2	3070.0 3	2590.0 3	1780.0 3	1470.0 3	1240.0 3	936.0 3	517.0 4
1950	12400.0 4	8890.0 3	5040.0 3	4460.0 2	2470.0 2	2340.0 1	1760.0 1	1510.0 1	1110.0 1	642.0 1
1951	7200.0 16	4950.0 18	2890.0 19	2140.0 11	1310.0 15	1120.0 11	1010.0 8	981.0 6	885.0 4	513.0 6
1952	1000.0 5	8100.0 4	3970.0 7	2430.0 5	1520.0 10	1320.0 7	1040.0 7	964.0 7	759.0 7	405.0 11
1953	1980.0 36	1770.0 35	1350.0 36	975.0 36	590.0 38	446.0 36	444.0 36	413.0 35	356.0 35	199.0 35
1954	1390.0 41	1020.0 41	671.0 42	495.0 42	433.0 40	293.0 40	228.0 40	191.0 41	141.0 41	75.8 41
1955	1480.0 40	1220.0 40	1040.0 39	869.0 38	700.0 35	553.0 35	459.0 35	411.0 36	340.0 37	196.0 36
1956	8000.0 10	5880.0 9	3050.0 16	1860.0 18	1120.0 23	735.0 30	623.0 30	577.0 28	539.0 18	363.0 14
1957	4950.0 25	3600.0 24	2280.0 27	1410.0 28	916.0 29	847.0 23	790.0 18	872.0 17	526.0 20	289.0 22
1958	7100.0 15	4260.0 21	2440.0 23	1670.0 22	1150.0 22	1050.0 14	934.0 11	840.0 10	646.0 11	481.0 8
1959	10500.0 7	7210.0 6	3540.0 18	1910.0 15	1710.0 6	1150.0 9	860.0 13	739.0 13	592.0 15	346.0 16
1960	4480.0 26	2680.0 31	1390.0 31	1030.0 34	653.0 38	445.0 37	373.0 37	342.0 37	344.0 36	222.0 32
1961	7850.0 12	5550.0 10	3120.0 13	2300.0 8	1720.0 5	1340.0 5	1270.0 4	1040.0 5	725.0 10	382.0 13
1962	3440.0 32	2760.0 30	1660.0 31	1170.0 32	1030.0 26	739.0 29	698.0 26	601.0 23	456.0 25	257.0 25
1963	13800.0 2	8030.0 5	4100.0 5	2340.0 7	1610.0 7	1090.0 17	739.0 21	574.0 29	401.0 32	219.0 33
1964	7520.0 13	5950.0 8	3760.0 6	2360.0 6	1560.0 8	1250.0 8	888.0 12	680.0 16	482.0 22	248.0 28
1965	4980.0 24	4040.0 23	2310.0 25	1300.0 30	974.0 27	749.0 27	786.0 19	630.0 19	446.0 27	245.0 29
1966	1960.0 37	1610.0 37	1130.0 38	724.0 39	477.0 39	372.0 39	315.0 39	276.0 39	237.0 39	142.0 36
1967	5950.0 20	4590.0 19	2970.0 18	1710.0 20	1090.0 25	742.0 28	706.0 23	628.0 20	623.0 12	344.0 17
1968	12100.0 6	7170.0 7	4410.0 4	2450.0 4	1440.0 12	950.0 18	807.0 16	666.0 18	579.0 16	400.0 12
1969	5660.0 21	4240.0 22	2650.0 21	1950.0 14	1390.0 13	929.0 19	752.0 20	615.0 22	581.0 17	425.0 10
1970	3310.0 33	2180.0 33	1600.0 32	1030.0 35	883.0 32	674.0 31	596.0 31	530.0 31	436.0 28	251.0 26
1971	3770.0 30	3060.0 28	2440.0 24	1610.0 25	1160.0 21	761.0 25	588.0 32	486.0 33	404.0 31	243.0 31
1972	2110.0 35	1790.0 34	1390.0 35	1170.0 31	866.0 31	629.0 33	547.0 34	479.0 34	421.0 30	244.0 30
1973	4200.0 27	3240.0 26	2280.0 28	1650.0 23	1260.0 16	1010.0 16	794.0 17	714.0 14	742.0 9	489.0 7

FLATACK RIVER AT ST. PAUL, IND. (CONTINUED)

STATISTICS ON MONTHLY MEANS (ALL DAYS)

OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT
BY ROWS (MEAN, VARIANCE, STANDARD DEVIATION, SKEWNESS, COEFF. OF VARIATION, PERCENTAGE OF AVERAGE FLOW)											
0.7792E+02	0.1932E+03	0.3070E+03	0.3303E+03	0.3101E+03	0.5950E+03	0.5670E+03	0.3940E+03	0.2700E+03	0.1748E+03	0.6953E+02	0.6054E+02
0.1721E+03	0.6418E+03	0.5477E+03	0.5648E+03	0.1430E+04	0.1595E+04	0.1365E+04	0.9644E+03	0.5831E+03	0.3593E+03	0.1276E+03	0.4958E+02
0.1312E+03	0.2430E+03	0.3144E+03	0.2715E+03	0.3792E+03	0.3196E+03	0.3895E+03	0.3105E+03	0.2415E+03	0.1694E+03	0.1129E+03	0.7042E+02
0.2911E+01	0.2047E+01	0.1093E+01	0.2629E+01	0.1151E+01	0.8340E+00	0.5740E+00	0.1361E+01	0.1400E+01	0.2058E+01	0.3863E+01	0.1705E+01
0.1603E+01	0.1361E+01	0.1021E+01	0.1398E+01	0.7433E+00	0.6705E+00	0.6517E+00	0.7867E+00	0.8945E+00	0.1084E+01	0.1624E+01	0.1163E+01
0.2073E+01	0.5139E+01	0.8108E+01	0.1432E+02	0.1357E+02	0.1584E+02	0.1500E+02	0.1050E+02	0.7161E+01	0.4630E+01	0.1849E+01	0.1610E+01

STATISTICS ON ANNUAL MEANS (ALL DAYS)

MEAN	VARIANCE	STANDARD DEVIATION	SKEWNESS	COEFF. OF VARIATION	SERIAL CORR
0.5123E+03	0.2086E+05	0.1444E+03	0.3073E+00	0.4626E+00	0.3576E+00

STATISTICS ON LOG MONTHLY MEANS (ALL DAYS)

OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT
BY ROWS (MEAN, VARIANCE, STANDARD DEVIATION, SKEWNESS, COEFF. OF VARIATION, PERCENTAGE OF AVERAGE FLOW)											
0.1503E+01	0.1925E+01	0.2194E+01	0.2425E+01	0.2540E+01	0.2659E+01	0.2640E+01	0.2472E+01	0.2258E+01	0.2003E+01	0.1582E+01	0.1477E+01
0.3274E+00	0.3402E+00	0.3336E+00	0.2629E+00	0.2096E+00	0.1250E+00	0.1208E+00	0.1180E+00	0.1700E+00	0.2444E+00	0.1874E+00	0.3049E+00
0.5722E+00	0.5932E+00	0.5775E+00	0.5319E+00	0.5780E+00	0.3536E+00	0.3475E+00	0.3410E+00	0.4123E+00	0.4940E+00	0.4329E+00	0.5322E+00
0.3388E+00	0.2836E+00	0.3381E+00	0.2633E+00	0.1411E+00	0.7366E+00	0.6177E+00	0.1734E+00	0.1994E+00	0.2334E+00	0.7206E+00	0.3157E+00
0.3807E+00	0.3030E+00	0.4232E+00	0.4153E+00	0.1803E+00	0.1330E+00	0.1317E+00	0.1302E+00	0.1825E+00	0.2466E+00	0.2736E+00	0.3738E+00
0.5552E+01	0.7496E+01	0.8545E+01	0.9445E+01	0.9890E+01	0.1035E+02	0.1028E+02	0.9627E+01	0.8795E+01	0.7801E+01	0.6162E+01	0.5753E+01

STATISTICS ON LOG ANNUAL MEANS (ALL DAYS)

MEAN	VARIANCE	STANDARD DEVIATION	SKEWNESS	COEFF. OF VARIATION	SERIAL CORR
0.2436E+01	0.4404E+01	0.2531E+00	-0.1238E+01	0.1039E+00	0.2652E+00

ANNUAL PEAKS

1931	1140
1932	6700
1933	10200
1934	4000
1935	2050
1936	4000
1937	18000
1938	4800
1939	9350
1940	7800
1941	2400
1942	4800
1943	10000
1944	9300
1945	7600
1946	2800
1947	9170
1948	7000
1949	18500
1950	14500
1951	8400
1952	15000
1953	2200
1954	1520
1955	3650
1956	10800
1957	6400
1958	7100
1959	14500
1960	6200
1961	11000
1962	3700
1963	17100
1964	9200
1965	8500
1966	2200
1967	8700
1968	17000
1969	6110
1970	4740
1971	4620
1972	2500
1973	4900

Appendix B.

Low Flow Drainage Characteristics (9).

LOCATION.--Lat 39°25'03", long 85°38'03", in NE 1/4 sec. 9, T. 11 N., R. 8 E., Shelby County, on right bank 500 ft downstream from highway bridge, 0.8 mile southwest of St. Paul, and 1.5 miles downstream from Mill Creek.

DRAINAGE AREA.--303 sq mi.

DISCHARGE DATA AVAILABLE.--October 1930 to September 1967. Prior to October 1958, published as Flatrock Creek at St. Paul.

SELECTED DISCHARGE CHARACTERISTICS.--

Average discharge: 307 cfs (37 years)

Minimum daily discharge:

.6 cfs August 1931

1-day, 30-year low flow:

.6 cfs

WATER INTAKES AND SEWER OUTFALLS.--Slight occasional diversion by quarry above gauge.

Magnitude and frequency of annual low flow

Magnitude and frequency of summer low flow

Period (Consecutive days)	Discharge, in cfs, for indicated recurrence interval, in years				
	2	5	10	20	50
1	6.5	2.3	1.3	0.8	0.4
3	6.8	2.5	1.4	.9	.5
7	7.9	2.9	1.7	1.0	.6
14	9.1	3.8	2.3	1.5	1.0
30	12	5.2	3.3	2.2	1.4
60	18	8.1	5.5	3.9	2.7

Period (Consecutive days)	Discharge, in cfs, for indicated recurrence interval, in years				
	2	5	10	20	50
1	11	4.2	2.3	1.3	0.7
3	12	4.5	2.5	1.5	.8
7	14	5.4	3.0	1.9	1.0
14	17	7.2	4.6	3.2	2.2
30	27	12	8.0	6.0	4.3
60	55	26	16	11	7.0

Duration of daily flow for indicated period

Months	Period	Discharge, in cfs, which was exceeded for indicated percent of time during 1931-67 water years						
		98	95	90	80	70	50	10
3	Aug.-Oct.	1.7	2.6	5.0	8.9	13	22	67
6	May-Oct.	2.3	4.5	8.0	15	23	51	195
3	June-Aug.	3.4	6.7	12	20	29	55	168
12	Oct.-Sept.	3.7	7.9	13	24	37	105	390
								690

03364400 Clifty Creek at Sandusky, Ind.

LOCATION.--Lat 39°25'27", long 85°28'48", in NE 1/4 NE 1/4 sec. 11, T. 11 N., R. 9 E., Decatur County, at bridge on State Highway 3, in Sandusky.

DRAINAGE AREA.--46.4 sq mi.

DISCHARGE DATA AVAILABLE.--Low-flow measurements, 1969-70 water years.

SELECTED DISCHARGE CHARACTERISTICS.--Minimum flow observed:	0.2 cfs	October 1963
7-day, 2-year low flow:	.2 cfs	
7-day, 10-year low flow:	0 cfs	
50% daily flow duration:	12 cfs	
90% daily flow duration:	.5 cfs	

03364500 Clifty Creek at Hartsville, Ind.

LOCATION.--Lat 39°16'25", long 85°42'10", in NW 1/4 sec. 36, T. 10 N., R. 7 E., Bartholomew County, at downstream side of left abutment of highway bridge, 0.2 mile north of Hartsville, and 5 miles upstream from Duck Creek.

DRAINAGE AREA.--91.4 sq mi.

DISCHARGE DATA AVAILABLE.--February 1948 to September 1967.

SELECTED DISCHARGE CHARACTERISTICS.--

Average discharge: 96.5 cfs (19 years)

Minimum daily discharge: No flow at times most years

1-day, 30-year low flow: 0 cfs

Magnitude and frequency of annual low flow

Magnitude and frequency of summer low flow

Period (Consecutive days)	Discharge, in cfs, for indicated recurrence interval, in years				
	2	5	10	20	50
1	0	0	0	0	---
3	0	0	0	0	---
7	.1	0	0	0	---
14	.2	0	0	0	---
30	.7	0	0	0	---
60	2.0	.1	0	0	---

Period (Consecutive days)	Discharge, in cfs, for indicated recurrence interval, in years				
	2	5	10	20	50
1	0.2	0	0	0	---
3	.3	0	0	0	---
7	.5	0	0	0	---
14	.9	0	0	0	---
30	3.9	1.0	.3	0	---
60	19	5.9	2.5	0	---

Duration of daily flow for indicated period

Months	Period	Discharge, in cfs, which was exceeded for indicated percent of time during 1949-67 water years							
		98	95	90	80	70	50	20	10
3	Aug.-Oct.	0	0	0	0	0.4	1.9	12	26
6	May-Oct.	0	0	0	.7	2.2	8.4	41	85
3	June-Aug.	0	0	.3	1.8	3.3	8.4	41	85
12	Oct.-Sept.	0	0	.3	2.3	6.4	26	107	212

03364800 Sand Creek near Greensburg, Ind.

LOCATION.--Lat 39°20'55", long 85°26'51", in NE 1/4 sec. 6, T. 10 N., R. 10 E., Decatur County, at county highway bridge,
1.5 miles northeast of Greensburg.

DRAINAGE AREA.--9.16 sq mi.

DISCHARGE DATA AVAILABLE.--Low-flow measurements, 1960-65, 1967 water years.

SELECTED DISCHARGE CHARACTERISTICS.--Minimum flow observed: No flow at times
7-day, 2-year low flow: 0 cfs
7-day, 10-year low flow: 0 cfs
50% daily flow duration: 1.0 cfs
90% daily flow duration: 0 cfs

03365000 Sand Creek near Brewersville, Ind.

LOCATION.--Lat 39°05'03", long 85°39'32", in NW 1/4 sec. 5, T. 7 N., R. 8 E., Jennings County, on left bank at downstream side of county highway bridge, 2.5 miles west of Brewersville, 5.7 miles upstream from Wyalosing Creek, and 16 miles upstream from mouth.

DRAINAGE AREA.--155 sq mi.

DISCHARGE DATA AVAILABLE.--February 1948 to September 1967.

SELECTED DISCHARGE CHARACTERISTICS.-- Average discharge: 165 cfs (19 years)
Minimum daily discharge: No flow at times most years
1-day, 30-year low flow: 0 cfs

Magnitude and frequency of annual low flow Magnitude and frequency of summer low flow

Period (Consecutive days)	Discharge, in cfs, for indicated recurrence interval, in years				
	2	5	10	20	50
1	0.9	0	0	0	---
3	.9	0	0	0	---
7	1.1	0	0	0	---
14	1.4	.1	0	0	---
30	3.0	.6	0	0	---
60	5.7	1.2	0	0	---

Period (Consecutive days)	Discharge, in cfs, for indicated recurrence interval, in years				
	2	5	10	20	50
1	2.0	0.4	0	0	---
3	2.1	.5	.1	0	---
7	2.7	.9	.2	0	---
14	4.4	1.0	.3	0	---
30	9.0	3.2	1.8	.7	---
60	30	8.0	3.6	1.8	---

Duration of daily flow for indicated period

Months	Period	Discharge, in cfs, which was exceeded for indicated percent of time during 1949-67 water years							
		98	95	90	80	70	50	20	10
3	Aug.-Oct.	0	0	0.1	1.0	2.1	5.5	23	47
6	May-Oct.	0	.1	.8	2.9	5.3	15	65	140
3	June-Aug.	.1	1.0	2.0	4.5	7.1	15	57	132
12	Oct.-Sept.	0	.5	2.0	5.6	13	35	157	340

Appendix C.

Engineering Soil Properties of Decatur County Soils (2).

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C-1. Engineering Soil Properties of Decatur County Soils. (2).

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches Pct	Percentage passing sieve number--				Liquid limit Pct	Plas-ticity index
			Unified	AASHTO							
						4	10	40	200		
	<u>in</u>										
AvA, AvB----- Avonburg	0-13	Silt loam-----	CL, ML, CL-ML	A-4	0	100	100	95-100	75-95	20-30	2-10
	13-27	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	75-95	30-45	10-20
	27-76	Silty clay loam, silt loam.	CL	A-6, A-7	0-3	95-100	95-100	90-100	70-95	30-45	10-20
	76-80	Clay loam, loam, silt loam.	CL	A-6, A-7	0-3	95-100	90-100	75-95	60-85	30-45	10-20
Cg----- Chagrin	0-8	Loam-----	ML, CL, CL-ML	A-4	0	95-100	85-100	80-100	70-90	20-35	2-10
	8-60	Silt loam, loam, sandy loam.	ML, SM	A-4, A-2, A-6	0	90-100	75-100	55-90	30-80	20-40	NP-14
Ch----- Chagrin Variant	0-7	Silt loam-----	CL, CL-ML	A-4	0	95-100	90-100	80-100	60-90	20-30	5-10
	7-25	Silt loam, loam	CL, CL-ML	A-4, A-6	0	95-100	90-100	80-100	60-90	20-30	7-12
	25	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
CkE2, CkC2----- Cincinnati	0-8	Silt loam-----	ML, CL	A-4, A-6	0	100	100	90-100	80-100	25-40	3-16
	8-26	Silty clay loam, silt loam.	CL	A-6, A-4	0	95-100	90-100	90-100	70-100	26-40	8-15
	26-60	Clay loam, loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	95-100	85-100	75-95	65-85	25-40	6-20
	60-80	Clay loam, loam.	CL, ML, CL-ML	A-6, A-4	0	95-100	85-100	75-95	65-95	25-40	5-20
CkC3----- Cincinnati	0-4	Silt loam-----	ML, CL	A-4, A-6	0	100	100	90-100	80-100	25-40	3-16
	4-16	Silty clay loam, silt loam.	CL	A-6, A-4	0	95-100	90-100	90-100	70-100	26-40	8-15
	16-60	Clay loam, loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	95-100	85-100	75-95	65-85	25-40	6-20
	60-80	Clay loam, loam	CL, ML, CL-ML	A-6, A-4	0	95-100	85-100	75-95	65-95	25-40	5-20
Cm----- Clermont	0-19	Silt loam-----	CL, CL-ML, ML	A-4, A-6	0	95-100	95-100	85-95	75-90	22-40	3-18
	19-43	Silty clay loam, silt loam.	CL	A-6, A-7	0	95-100	95-100	90-100	85-95	30-45	12-25
	43-80	Silt loam, silty clay loam.	CL	A-6, A-7	0	95-100	85-100	75-95	65-90	32-48	12-28
CnG*----- Corydon	0-3	Silt loam-----	CL, CL-ML	A-4, A-6	0-5	80-95	80-95	75-90	55-85	16-24	5-15
	3-15	Silt loam, loam	CL, ML-CL	A-6, A-4	0-5	80-95	80-95	75-90	55-85	16-28	5-15
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
CrA----- Crosby	0-10	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	95-100	80-100	50-90	22-34	6-15
	10-27	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0-3	92-99	89-97	78-93	64-76	37-55	17-31
	27-60	Loam, clay loam, sandy loam.	CL, ML, CL-ML	A-4, A-6	0-3	88-94	83-89	74-87	50-64	17-30	2-14
Cy----- Cyclone	0-16	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	100	95-100	80-95	25-40	5-15
	16-46	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-50	15-30
	46-60	Silt loam	CL, CL-ML	A-4, A-6	0	95-100	85-100	80-95	50-80	25-40	4-15
	60-65	Loam, clay loam, sandy loam.	CL-ML, CL	A-4, A-6	0	90-100	85-100	75-95	50-75	20-30	6-15

See footnote at end of table.

C-1. (continued) (2).

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	in				Pct					Pct	
FcA, FcB----- Pincastle	0-10	Silt loam-----	CL, ML	A-4, A-6	0	100	55-100	90-100	75-93	27-36	4-12
	10-27	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	95-100	85-95	38-54	20-32
	27-54	Clay loam, loam	CH, CL	A-7	0	95-100	90-98	85-95	75-85	45-58	30-38
	54-60	Loam, fine sandy loam.	CL, ML, CL-ML	A-4, A-6	0-3	88-96	82-90	70-86	50-66	20-35	3-12
PoA, PoB----- Fox	0-10	Loam-----	ML, CL, CL-ML	A-4	0	95-100	85-100	75-95	55-90	20-30	3-10
	10-30	Clay loam, loam, sandy clay loam.	CL, SC	A-2, A-6, A-7	0-5	85-100	70-95	50-95	20-65	25-45	10-25
	30-60	Stratified sand to gravel.	SP, SM, GP, GM	A-1, A-2, A-3	0-10	40-100	35-100	15-95	2-20	---	NP
GrD----- Grayford	0-7	Silt loam-----	CL-ML, CL	A-4	0	100	100	90-100	70-90	18-30	4-10
	7-40	Clay loam, silty clay loam, loam.	CL	A-6, A-4	0-5	95-100	85-100	75-100	60-95	25-40	8-15
	40-48	Clay, silty clay, clay loam.	CH	A-7	0-10	95-100	65-95	60-90	50-85	45-55	15-25
	48	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
GrC2*:----- Grayford	0-7	Silt loam-----	CL-ML, CL	A-4	0	100	100	90-100	70-90	18-30	4-10
	7-36	Clay loam, silty clay loam, loam.	CL	A-6, A-4	0-5	95-100	85-100	75-100	60-95	25-40	8-15
	36-42	Clay, silty clay, clay loam.	CH	A-7	0-10	95-100	65-95	60-90	50-85	45-55	15-25
	42	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ryker-----	0-7	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	90-100	80-95	25-35	5-15
	7-30	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	75-95	30-45	15-25
	30-59	Silt loam, silty clay loam, clay loam.	CL	A-6, A-7	0	85-98	80-98	75-95	60-85	30-45	15-25
	59-80	Loam, silty clay, clay, clay loam.	CL, CH	A-7	0	80-95	75-95	75-95	60-85	40-60	20-30
HeG----- Hennepin	0-3	Loam-----	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	70-100	60-95	25-40	5-20
	3-17	Loam-----	SC, SM-SC, CL, CL-ML	A-4, A-6, A-7	0-5	85-100	80-100	65-100	35-95	20-50	5-25
	17-60	Loam, sandy loam	SC, SM-SC, CL, CL-ML	A-4, A-6, A-7	0-5	85-100	80-100	65-100	35-95	20-50	5-25
HkD2, HkE2, HkF----- Hickory	0-5	Loam-----	CL	A-6, A-4	0-5	95-100	90-100	90-100	85-95	20-35	8-15
	5-52	Clay loam, silt loam, silty clay loam.	CL	A-6, A-7	0-5	100	90-100	80-95	75-90	30-50	15-30
	52-60	Clay loam, loam	CL-ML, CL	A-4, A-6	0-5	85-100	85-95	80-95	60-80	20-40	5-20
H1D3----- Hickory	0-4	Clay loam-----	CL	A-6, A-7	0-5	95-100	90-100	80-95	75-90	30-50	15-30
	4-48	Clay loam-----	CL	A-6, A-7	0-5	100	90-100	80-95	75-90	30-50	15-30
	48-60	Clay loam, loam.	CL-ML, CL	A-4, A-6	0-5	85-100	85-95	80-95	60-80	20-40	5-20
Lb----- Lobdell	0-8	Silt loam-----	ML, CL-ML, CL	A-4	0	95-100	90-100	80-100	65-90	20-30	NP-8
	8-60	Loam, silt loam, fine sandy loam.	ML	A-4	0	90-100	80-100	70-95	55-85	20-35	NP-10
MeA, MeB2----- Martinsville	0-7	Loam-----	CL, CL-ML	A-4, A-6	0	100	90-100	80-100	60-90	22-33	4-12
	7-44	Clay loam, silty clay loam, sandy clay loam, sandy loam.	CL, SC	A-4, A-6	0	100	90-100	65-90	40-90	20-35	8-20
	44-70	Sandy loam, sandy clay loam.	SM, ML	A-2-4, A-4	0	100	90-100	60-80	30-60	30-40	2-8
	70-75	Stratified sand to silt loam.	CL, SC, CL-ML, SM-SC	A-4	0	95-100	85-100	80-95	40-60	<25	4-9

See footnote at end of table.

C-1. (continued) (2).

Soil name and map symbol	Depth in	USDA texture	Classification		Frag- ments > 3 inches Pot	Percentage passing sieve number--				Liquid limit Pot	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
MmB2, MmC2, MmD2- Miami	0-7	Silt loam-----	CL, CL-ML, ML	A-4	0	100	95-100	80-100	50-90	15-30	3-10
	7-30	Clay loam, silty clay loam.	CL, SC	A-6	0	90-100	85-100	70-95	40-95	30-40	15-25
	30-60	Loam, sandy loam	CL, CL-ML, ML, SC	A-4, A-6	0-3	85-95	90-100	70-90	45-70	20-30	5-11
MoC3, MoD3----- Miami	0-6	Clay loam-----	CL	A-6	0	100	90-100	75-95	65-95	30-40	15-20
	6-26	Clay loam-----	CL, SC	A-6	0	90-100	85-100	70-95	40-95	30-40	15-25
	26-60	Loam, clay loam, sandy loam.	CL, CL-ML, ML, SC	A-4, A-6	0-3	85-95	90-100	70-90	45-70	20-30	5-11
Mr----- Wilford	0-14	Silty clay-----	CL, CH	A-7	0	100	95-100	90-100	80-95	40-60	20-35
	14-47	Silty clay, silty clay loam.	CH, CL	A-7	0	100	95-100	90-100	75-100	40-60	20-40
	47-60	Stratified silty clay to loam.	CL	A-6, A-7	0	97-100	95-100	90-100	70-100	30-50	15-30
Ms----- Millsdale	0-9	Silty clay loam	CL	A-6, A-7	0	90-100	80-100	75-100	60-95	32-50	12-25
	9-36	Clay, silty clay loam, clay loam.	CH, CL	A-7	0-5	85-100	80-100	75-100	60-95	40-60	20-35
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
MtA, MtB2----- Milton	0-11	Silt loam-----	ML, CL	A-4, A-6	0	95-100	90-100	85-100	70-95	26-36	4-12
	11-24	Silty clay loam, clay loam, clay.	CL	A-6, A-7	0	95-100	80-100	75-100	70-95	32-48	12-28
	24-34	Clay, silty clay loam, silty clay	CH, CL	A-7, A-6	0-5	95-100	80-100	70-95	50-90	32-55	14-33
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
My----- Montgomery	0-14	Silty clay-----	CL	A-7	0	100	100	100	85-98	40-50	20-28
	14-38	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-98	55-65	34-42
	38-43	Silt loam, clay loam.	CL, SC	A-6	0-5	65-100	60-90	55-80	45-70	30-40	18-28
	43-60	Gravelly sandy loam, gravelly loam.	CL, GC, SC	A-2, A-4, A-6, A-7	0-10	55-85	50-80	40-75	25-55	30-45	8-20
OcA, OcB----- Ockley	0-14	Silt loam-----	CL, ML, CL-ML	A-4, A-6	0	100	95-100	80-100	60-90	22-33	3-12
	14-26	Silt loam, loam, silty clay loam, clay loam.	CL	A-6, A-7	0	100	75-100	65-90	50-90	35-50	15-30
	26-45	Gravelly clay loam, gravelly loam, gravelly sandy clay loam.	CL, SC, GC	A-6, A-7	0-2	70-85	45-75	40-70	35-55	30-50	15-30
	45-60	Stratified sand to gravelly sand.	SP, SP-SM, GP, GP-GM	A-1	1-5	30-70	20-55	5-20	2-10	---	NP
Or----- Orrville	0-10	Silt loam-----	ML, CL-ML, CL	A-4	0	100	90-100	85-100	60-80	22-35	4-10
	10-40	Silt loam, loam, fine sandy loam.	CL, CL-ML, ML	A-4, A-6	0-2	95-100	75-100	70-95	45-90	20-40	2-16
	40-60	Silt loam, loam, fine sandy loam.	CL, CL-ML, ML	A-4, A-6	0-2	95-100	75-100	70-95	45-90	20-40	2-16

See footnote at end of table.

C-1. (continued) (2).

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- tic index
			Unified	AASHTO		Pct					
						4	10	40	200		
	In				Pct					Pct	
RoG----- Rodman	0-8	Gravelly sandy loam.	SM-SC, SM	A-1, A-2, A-4	0-2	70-85	65-85	40-60	20-40	<25	NP-5
	8-13	Gravelly loam, sandy loam, loam.	ML, CL-ML, SM-SC, SM	A-4, A-2, A-1	0-2	70-85	60-85	40-75	20-55	<25	NP-5
	13-60	Stratified sand to gravelly sand.	SP, SP-SM, GP, GP-GM	A-1	1-5	30-70	22-55	7-20	2-10	---	NP
Rs92----- Rossmoyne	0-7	Silt loam-----	ML	A-4	0	90-100	90-100	90-100	85-100	30-40	4-10
	7-21	Silty clay loam, silt loam.	CL, ML	A-6, A-7, A-4	0	90-100	90-100	85-100	75-95	30-48	8-20
	21-72	Silt loam, loam, silty clay loam.	CL	A-6, A-4	0	90-100	85-95	80-90	70-85	25-40	9-19
	72-80	Clay loam, loam	CL	A-6, A-7, A-4	0	80-95	70-90	65-85	60-80	25-42	8-20
RuB----- Russell	0-12	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	95-100	80-100	50-90	20-35	5-15
	12-30	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	85-95	35-50	20-35
	30-50	Clay loam, loam	CL	A-6, A-7	0	90-100	90-95	80-90	65-75	35-50	17-31
	50-60	Loam, fine sandy loam.	CL, ML, CL-ML	A-4, A-6	0-3	85-95	80-90	75-85	50-65	<30	2-14
So----- Sloan	0-13	Silt loam, silty clay loam.	CL, ML, CL-ML	A-6, A-4	0	100	95-100	85-100	70-95	20-40	3-15
	13-44	Silty clay loam, clay loam, silt loam.	CL, ML	A-6, A-7, A-4	0	100	90-100	85-100	75-95	30-45	8-18
	44-60	Stratified gravelly sandy loam to silty clay loam.	ML, CL	A-4, A-6	0	95-100	70-100	60-95	50-90	25-40	3-15
Sr----- Starks	0-13	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	22-35	5-15
	13-25	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	80-100	35-45	15-24
	25-56	Sandy loam, loam, silty clay loam, clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	95-100	90-100	80-95	40-80	25-40	6-17
	56-80	Stratified loamy sand to silt loam.	SM, SC, ML, CL	A-2, A-4, A-6	0-5	90-100	80-95	40-90	30-60	<30	NP-15
St----- Stonelick	0-40	Fine sandy loam, sandy loam.	SM, ML, SM-SC, CL-ML	A-4, A-2	0	85-100	70-100	45-75	25-55	<24	NP-6
	40-60	Stratified loam to loamy sand.	SM, SP-SM	A-2, A-4, A-3, A-1-b	0	85-100	70-95	40-60	5-40	<15	NP
Ud*: Udorthents. Pits.											
WmB----- Williamstown	0-9	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	20-35	4-15
	9-33	Clay loam, silty clay loam.	CL	A-4, A-6	0	100	95-100	85-100	70-95	30-40	10-20
	33-37	Loam, clay loam	CL, CL-ML	A-6, A-4	0	100	95-100	80-95	60-80	20-35	5-15
	37-60	Loam-----	ML, CL-ML, CL	A-4, A-6	0-2	100	95-100	80-95	55-75	20-35	3-11
XnA, XnB----- Xenia	0-12	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	25-35	5-15
	12-29	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	80-95	35-50	15-30
	29-46	Clay loam-----	CL	A-6, A-7	0-5	92-100	90-95	75-95	65-75	35-50	15-30
	46-60	Loam-----	CL, ML	A-4, A-6	0-5	85-95	80-90	75-90	40-65	15-30	NP-15

* See description of the map unit for composition and behavior characteristics of the map unit.

C-2. Physical and Chemical Properties of Decatur County Soils (2).

Soil name and map symbol	Depth		Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
	In	Pct						K	T		Pct
AvA, AvB----- Avonburg	0-13	10-18	1.30-1.45	0.6-2.0	0.20-0.24	4.5-7.3	Low-----	0.43	4	5	.5-2
	13-27	22-30	1.35-1.50	0.6-2.0	0.18-0.20	4.5-5.5	Moderate-----	0.43			
	27-76	22-30	1.60-1.85	<0.06	0.06-0.08	4.5-6.5	Moderate-----	0.43			
	76-80	14-30	1.50-1.70	<0.06	0.06-0.10	4.5-8.4	Moderate-----	0.43			
Gr----- Chagrin	0-8	10-27	1.20-1.40	0.6-2.0	0.20-0.24	5.6-7.3	Low-----	0.32	5	5	2-4
	8-60	18-30	1.20-1.50	0.6-2.0	0.14-0.20	5.6-7.3	Low-----	0.32			
Ch----- Chagrin Variant	0-7	15-22	1.30-1.45	0.6-2.0	0.20-0.22	6.1-7.3	Low-----	0.37	4	5	1-4
	7-25	18-25	1.30-1.45	0.6-2.0	0.17-0.19	6.1-7.3	Low-----	0.37			
CkB2, CkC2----- Cincinnati	0-8	15-25	1.30-1.50	0.6-2.0	0.22-0.24	4.5-7.3	Low-----	0.37	4-3	6	1-3
	8-26	22-35	1.45-1.65	0.6-2.0	0.15-0.19	4.5-5.5	Low-----	0.37			
	26-60	24-43	1.60-1.85	0.06-0.6	0.08-0.12	4.5-6.5	Moderate-----	0.37			
	60-80	24-40	1.55-1.75	0.06-0.6	0.08-0.12	4.5-6.5	Moderate-----	0.37			
CkC3----- Cincinnati	0-4	15-27	1.30-1.50	0.6-2.0	0.22-0.24	4.5-7.3	Low-----	0.37	4-3	6	1-3
	4-16	22-35	1.45-1.65	0.6-2.0	0.15-0.19	4.5-5.5	Low-----	0.37			
	16-60	24-43	1.60-1.85	0.06-0.6	0.08-0.12	4.5-6.5	Moderate-----	0.37			
	60-80	24-40	1.55-1.75	0.06-0.6	0.08-0.12	4.5-6.5	Moderate-----	0.37			
Cm----- Clermont	0-19	13-27	1.30-1.55	0.2-0.6	0.22-0.24	4.5-7.3	Low-----	0.37	5	6	1-3
	19-43	25-35	1.45-1.65	<0.06	0.18-0.22	4.5-5.5	Moderate-----	0.37			
	43-80	27-40	1.45-1.70	<0.06	0.10-0.18	5.1-7.3	Moderate-----	0.37			
Cn3*:----- Corydon	0-3	10-18	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.8	Low-----	0.32	2	6	2-4
	3-15	10-23	1.30-1.55	0.6-2.0	0.11-0.20	5.6-7.8	Moderate-----	0.32			
	15	---	---	---	---	---	---	---			
Rock outcrop.											
CrA----- Crosby	0-10	11-22	1.40-1.55	0.6-2.0	0.20-0.24	5.1-6.5	Low-----	0.43	3	5	1-3
	10-27	27-35	1.50-1.70	0.06-0.2	0.15-0.20	5.1-7.3	Moderate-----	0.43			
	27-60	15-32	1.70-2.00	0.06-0.6	0.05-0.19	7.4-8.4	Low-----	0.43			
Cy----- Cyclone	0-16	18-27	1.30-1.50	0.6-2.0	0.23-0.25	6.1-7.3	Low-----	0.28	5	6	4-6
	16-46	27-35	1.40-1.60	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43			
	46-60	15-25	1.40-1.60	0.6-2.0	0.15-0.19	6.6-7.8	Low-----	0.43			
	60-65	15-25	1.50-1.80	0.2-0.6	0.05-0.19	7.4-8.4	Low-----	0.43			
FcA, FcB----- Fincastle	0-10	11-22	1.40-1.55	0.6-2.0	0.22-0.24	5.1-6.5	Low-----	0.37	5	5	1-3
	10-27	20-35	1.45-1.65	0.2-0.6	0.18-0.20	5.1-7.3	Moderate-----	0.37			
	27-54	20-35	1.45-1.65	0.2-0.6	0.15-0.19	5.1-7.3	Moderate-----	0.37			
	54-60	13-30	1.55-1.90	0.06-2.0	0.05-0.19	7.4-8.4	Low-----	0.37			
FcA, FcB----- Fox	0-10	10-17	1.35-1.55	0.6-2.0	0.20-0.24	5.1-7.3	Low-----	0.32	4	5	1-3
	10-30	25-35	1.55-1.65	0.6-2.0	0.15-0.19	5.6-8.4	Moderate-----	0.32			
	30-60	0-2	1.30-2.20	>6.0	0.02-0.04	7.4-8.4	Low-----	0.10			
GrD----- Grayford	0-7	12-25	1.25-1.40	0.6-2.0	0.20-0.24	5.1-7.3	Low-----	0.37	5-4	5	.5-2
	7-40	20-35	1.40-1.60	0.6-2.0	0.16-0.20	4.5-5.5	Moderate-----	0.37			
	40-48	42-50	1.40-1.60	0.6-2.0	0.09-0.11	5.1-7.3	High-----	0.37			
	48	---	---	---	---	---	---	---			
GrC2*:----- Grayford	0-7	12-25	1.25-1.40	0.6-2.0	0.20-0.24	5.1-7.3	Low-----	0.37	5-4	5	.5-2
	7-36	20-35	1.40-1.60	0.6-2.0	0.16-0.20	4.5-5.5	Moderate-----	0.37			
	36-42	42-50	1.40-1.60	0.6-2.0	0.09-0.11	5.1-7.3	High-----	0.37			
	42	---	---	---	---	---	---	---			

See footnote at end of table.

C-2. (continued) (2).

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors	Wind erodi- bility	Organic matter	
	In	Pct	G/cm ³	In/hr	In/in	pH		K	T	group	Pct
GrC2: Ryker-----	0-7	15-27	1.35-1.50	0.6-2.0	0.22-0.24	5.1-7.3	Low-----	0.37	5	5	1-4
	7-30	20-35	1.40-1.60	0.6-2.0	0.18-0.22	4.5-7.3	Moderate-----	0.37			
	30-59	20-35	1.45-1.65	0.6-2.0	0.15-0.20	4.5-6.0	Moderate-----	0.37			
	59-80	35-50	1.45-1.65	0.6-2.0	0.09-0.20	4.5-6.0	Moderate-----	0.37			
He3-----	0-3	20-30	1.20-1.40	0.6-2.0	0.18-0.24	6.1-7.8	Low-----	0.32	4	5	1-2
Hennepin	3-17	18-30	1.30-1.60	0.2-2.0	0.14-0.22	6.1-7.8	Low-----	0.32			
	17-60	13-23	1.45-1.70	0.06-0.6	0.07-0.11	6.1-8.4	Low-----	0.32			
HkD2, HkE2, HkF-----	0-5	19-27	1.30-1.50	0.6-2.0	0.20-0.22	4.5-6.0	Low-----	0.37	5	6	1-2
Hickory	5-52	20-35	1.45-1.65	0.6-2.0	0.15-0.19	4.5-5.5	Moderate-----	0.37			
	52-60	15-32	1.50-1.70	0.6-2.0	0.11-0.19	5.1-8.4	Low-----	0.37			
HLD3-----	0-4	27-35	1.40-1.65	0.6-2.0	0.17-0.19	4.5-6.0	Moderate-----	0.37	4	4	.5-1
Hickory	4-48	27-35	1.45-1.65	0.6-2.0	0.15-0.19	4.5-5.5	Moderate-----	0.37			
	48-60	15-32	1.50-1.70	0.6-2.0	0.11-0.19	5.1-8.4	Low-----	0.37			
Lb-----	0-8	15-27	1.20-1.40	0.6-2.0	0.20-0.24	5.1-7.3	Low-----	0.37	5	5	1-3
Lobdell	8-60	18-30	1.25-1.60	0.6-2.0	0.17-0.22	5.1-7.3	Low-----	0.37			
MeA, MeP2-----	0-7	8-17	1.30-1.45	0.6-2.0	0.20-0.24	5.6-7.3	Low-----	0.37	5	5	1-3
Martinsville	7-44	18-30	1.40-1.60	0.6-2.0	0.17-0.20	5.1-6.0	Moderate-----	0.37			
	44-70	10-25	1.40-1.60	0.6-2.0	0.12-0.14	5.6-7.3	Low-----	0.24			
	70-75	3-23	1.50-1.70	0.6-2.0	0.19-0.21	7.4-8.4	Low-----	0.24			
MmB2, MmC2, MmD2-----	0-7	11-22	1.30-1.45	0.6-2.0	0.20-0.24	5.6-7.3	Low-----	0.37	5	5	.5-3
Miami	7-30	25-35	1.45-1.65	0.6-2.0	0.15-0.20	5.1-7.3	Moderate-----	0.37			
	30-60	15-25	1.55-1.90	0.2-0.6	0.05-0.19	6.6-8.4	Moderate-----	0.37			
MoC3, MoD3-----	0-6	27-35	1.35-1.60	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.37	4	6	.5-3
Miami	6-26	25-35	1.45-1.65	0.6-2.0	0.15-0.20	5.1-7.3	Moderate-----	0.37			
	26-60	15-25	1.55-1.90	0.2-0.6	0.05-0.19	7.4-8.4	Moderate-----	0.37			
Mr-----	0-14	35-42	1.30-1.50	0.6-2.0	0.12-0.23	5.6-7.3	High-----	0.28	5	4	5-6
Wilford	14-47	35-42	1.45-1.65	0.2-0.6	0.18-0.20	5.1-7.8	Moderate-----	0.43			
	47-60	20-30	1.50-1.70	0.2-0.6	0.20-0.22	7.4-8.4	Moderate-----	0.43			
Mg-----	0-9	27-32	1.30-1.50	0.6-2.0	0.19-0.22	6.1-7.3	Moderate-----	0.32	4	6	4-7
Millsdale	9-36	35-45	1.40-1.70	0.2-0.6	0.12-0.16	6.1-8.4	High-----	0.32			
	36	---	---	---	---	---	---	---			
MtA, MtB2-----	0-11	14-27	1.30-1.50	0.6-2.0	0.18-0.23	5.1-7.3	Low-----	0.37	4	6	1-3
Milton	11-24	35-50	1.45-1.70	0.2-2.0	0.12-0.18	4.5-7.8	Moderate-----	0.37			
	24-34	25-50	1.40-1.70	0.2-2.0	0.12-0.16	5.1-7.8	Moderate-----	0.37			
	34	---	---	---	---	---	---	---			
My-----	0-14	35-40	1.35-1.55	0.2-0.6	0.21-0.23	6.1-7.3	High-----	0.28	4	7	5-8
Montgomery	14-38	40-55	1.45-1.65	0.06-0.2	0.11-0.13	6.6-7.8	High-----	0.28			
	38-43	30-40	1.50-1.70	0.2-2.0	0.09-0.15	7.4-7.8	Moderate-----	0.28			
	43-60	15-25	1.50-1.70	2.0-20	0.05-0.10	7.4-8.4	Low-----	0.28			
OcA, OcB-----	0-14	11-22	1.30-1.45	0.6-2.0	0.20-0.24	5.6-7.3	Low-----	0.37	5	5	.5-3
Ockley	14-26	27-35	1.45-1.60	0.6-2.0	0.15-0.20	4.5-7.3	Moderate-----	0.37			
	26-45	20-35	1.40-1.55	0.6-2.0	0.12-0.14	5.6-6.5	Moderate-----	0.24			
	45-60	2-5	1.60-1.80	>20	0.02-0.04	7.4-8.4	Low-----	0.10			
Or-----	0-10	12-27	1.25-1.45	0.6-2.0	0.18-0.22	5.1-7.3	Low-----	0.37	5	6	2-4
Orrville	10-40	12-27	1.30-1.50	0.6-2.0	0.15-0.19	5.1-6.5	Low-----	0.37			
	40-60	12-18	1.30-1.50	0.6-2.0	0.15-0.19	5.6-7.3	Low-----	0.37			
RoG-----	0-8	5-20	1.10-1.40	2.0-6.0	0.09-0.12	6.6-7.8	Low-----	0.15	3	8	---
Rodman	8-13	5-25	1.10-1.50	2.0-6.0	0.09-0.12	6.6-7.8	Low-----	0.20			
	13-60	0-10	>1.80	>20	0.02-0.04	7.4-8.4	Low-----	0.10			

See footnote at end of table.

C-2. (continued) (2).

Soil name and map symbol	Depth		Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
	ft.	Pct						K	T		
RsB2 Rossmoyne	0-	13-27	1.35-1.50	0.6-2.0	10.20-0.24	4.5-7.3	Low-----	0.37	4	6	1-3
	7-21	22-35	1.40-1.60	0.6-2.0	10.14-0.19	4.5-5.5	Moderate-----	0.37			
	21-72	24-35	1.70-1.90	0.06-0.6	10.06-0.10	4.5-5.5	Moderate-----	0.37			
	72-80	18-45	1.60-1.75	0.06-0.6	10.06-0.10	5.6-8.4	Moderate-----	0.37			
RuR Russell	0-12	11-25	1.30-1.45	0.6-2.0	10.21-0.24	5.6-7.3	Low-----	0.37	5	5	.5-2
	12-30	25-33	1.40-1.60	0.6-2.0	10.18-0.20	4.5-6.5	Moderate-----	0.37			
	30-50	23-33	1.40-1.60	0.6-2.0	10.15-0.19	5.6-7.3	Moderate-----	0.37			
	50-60	14-30	1.60-1.80	0.6-2.0	10.05-0.19	7.4-8.4	Low-----	0.37			
So Sloan	0-13	15-27	1.20-1.40	0.6-2.0	10.20-0.24	6.1-7.8	Low-----	0.37	5	6	3-6
	13-44	15-35	1.25-1.55	0.2-2.0	10.15-0.19	6.1-8.4	Moderate-----	0.37			
	44-60	10-30	1.20-1.50	0.2-2.0	10.13-0.18	6.6-8.4	Low-----	0.37			
Sr Starks	0-13	15-27	1.15-1.35	0.6-2.0	10.22-0.24	5.6-7.3	Moderate-----	0.37	5	6	1-3
	13-25	22-35	1.35-1.55	0.2-2.0	10.18-0.20	5.1-6.5	Moderate-----	0.37			
	25-56	20-30	1.45-1.65	0.2-2.0	10.16-0.19	5.1-7.3	Moderate-----	0.37			
	56-80	5-20	1.55-1.75	2.0-6.0	10.08-0.18	5.6-8.4	Low-----	0.37			
St Stonelick	0-40	8-18	1.25-1.50	2.0-6.0	10.09-0.14	7.4-8.4	Low-----	0.24	5	3	.5-2
	40-60	5-18	1.20-1.55	2.0-6.0	10.05-0.11	7.4-8.4	Low-----	0.24			
Ud*: Udorthents. Fits.											
WmB Williamstown	0-9	14-26	1.30-1.45	0.6-2.0	10.22-0.24	5.6-7.3	Low-----	0.37	5	5	1-3
	9-33	27-35	1.35-1.50	0.6-2.0	10.15-0.21	5.6-7.3	Moderate-----	0.37			
	33-37	18-27	1.55-1.50	0.6-2.0	10.15-0.19	6.1-7.8	Low-----	0.37			
	37-60	16-26	1.45-1.70	0.2-0.6	10.05-0.19	7.4-8.4	Low-----	0.37			
XnA, XnB Xenia	0-12	11-22	1.40-1.55	0.6-2.0	10.22-0.24	6.6-7.3	Low-----	0.37	5	5	1-3
	12-29	25-35	1.45-1.65	0.2-0.6	10.18-0.20	5.1-6.0	Moderate-----	0.37			
	29-46	27-35	1.45-1.65	0.2-0.6	10.15-0.19	5.1-7.3	Moderate-----	0.37			
	46-60	13-27	1.55-1.90	0.2-2.0	10.05-0.19	7.3-8.4	Low-----	0.37			

* See description of the map unit for composition and behavior characteristics of the map unit.

Appendix D

Borehole Data.

Appendix D-1 Borehole Data For U.S. 421 over Gas Creek in Decatur County (33)

Boring No.	Sample No.	Highway Route No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size Distribution					Notes
							Texture	AASHTO		Recovery RQD	Gravel	Sand	Silt	Clay	
1	1	U.S. 421	99 + 55	30 L	925.8	0.0 - 14.0	Medium stiff silty loam with sand and gravel	-	10, 9, 4, 7	-	-	-	-	-	Moisture $\bar{x}$ 9.9
1	2	"	"	"	"	14.0 - 17.3	Medium stiff sandy clay loam	-	12	-	-	-	-	-	Moisture $\bar{x}$ 12.4
1	3	"	"	"	"	> 17.3	Medium hard grey limestone with chert	-	-	17%	-	-	-	-	8.T.H. 22.3 ft.
2	1	"	100 + 24	25 R	"	0.0 - 4.0	Loose sandy gravel	-	3.2	-	-	-	-	-	-
2	2	"	"	"	"	4.0 - 14.5	Soft moist brown loam	A-4(2)	2, 2, 1	-	15.7	24.4	45.1	14.8	Moisture $\bar{x}$ 18.2
2	3	"	"	"	"	14.5 - 18.2	Medium dense sandy gravel with limestone fragments	-	1.4	-	-	-	-	-	-
2	4	"	"	"	"	> 18.2	Medium hard grey limestone with chert	-	-	RC-1 95 RQD 0%	-	-	-	-	Rock core Refusal at 20.5ft

S.T.H. - Boring Total Height

Appendix D-2 Borehole Data for C.R. 45 over Little Flat Rock River in Decatur County (34).

Boring No.	Sample No.	Highway Route No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Recovery	Grain Size Distribution					Notes
							Texture	AASHTO			RQD	Gravel	Sand	Silt	Clay	LL PL PI
3	1	C.R. 45	23+24	12 L	870.6	0.0- 0.6	Topsoil	-	-	-	-	-	-	-	-	-
3	2	"	"	"	"	0.6- 5.4	Brown moist med. stiff clay loam	A-4	7.5	-	-	-	-	-	-	-
3	3	"	"	"	"	>5.4	Gray and brown hard limestone	-	-	81%	-	-	-	-	-	B.T.H. 10.4 ft
4	1	"	23+87	7 R	864.8	0.0- 1.8	Gray very dense gravelly sand	-	1.50/2	-	-	-	-	-	-	-
4	2	"	"	"	"	>1.8	Gray hard limestone	-	-	85%	-	-	-	-	-	B.T.H. 6.8 ft
5	1	"	24+51	12 L	869.6	0.0- 4.0	Brown moist very loose silty loam	A-4	2	-	-	-	-	-	-	-
5	2	"	"	"	"	4.0- 7.0	Brownish red med. dense silty loam	A-4(0)	6,4	-	0	28	54	18	23	22 1 -
5	3	"	"	"	"	7.0- 9.8	Blue green med. dense silty loam	A-4	7	-	-	-	-	-	-	-
5	4	"	"	"	"	9.8-17.3	Brown loose silty loam	A-4	5	-	-	-	-	-	-	-
5	5	"	"	"	"	>17.3	Gray hard calcitic limestone	-	-	80%	-	-	-	-	-	B.T.H. 22.3 ft
6	1	"	25+12	12 R	880.5	0.0- 0.2	Asphalt	-	-	-	-	-	-	-	-	-
6	2	"	"	"	"	0.2- 4.0	Brown med. dense sand & gravel	-	12	-	-	-	-	-	-	-
6	3	"	"	"	"	4.0- 8.5	Brown moist very stiff loam	A-4	13,9	-	-	-	-	-	-	-
6	4	"	"	"	"	8.5-14.9	Red moist hard clay w/rock fragments	A-7-6(21)	30/.5 40/.5	-	0	24	33	43	50	22 28 Max. dry density 108.3 pcf
6	5	"	"	"	"	14.9-16.9	Boulder	-	-	0%	-	-	-	-	-	-
6	6	"	"	"	"	16.9-35.9	Red moist hard clay w/rock fragments	A-7-6	28,24,16	-	-	-	-	-	-	B.T.H. 35.9 ft

Appendix D-3 Borehole Data on S.R. 46 over Fall Fork Creek in Decatur County (13)

Boring No.	Sample No.	Highway Route No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size Distribution				Notes
							Texture	AASHTO		Recovery RQD	Gravel	Sand	Silt Clay	LL PL PI
9	1	S.R. 46	932 + 89	23 R	787.3	0.0 - 5.5	Brown medium stiff clay loam with trace gravel	A-6(8)	2, 4	-	3.6	36.5	37.5 22.4 32.7	14.7/18.0 Optimum moisture content 15.0%
9	2	"	"	"	"	5.5 - 8.0	Brown soft sandy clay loam	-	2	-	-	-	-	-
9	3	"	"	"	"	8.0 - 12.0	Brown loose sand with trace silty clay	-	2	-	-	-	-	-
9	4	"	"	"	"	12.0 - 23.5	Gray medium stiff sandy gravel	-	5, 8	-	-	-	-	-
9	5	"	"	"	"	23.5 - 24.0	Light gray limestone dolomite with chert	-	12-55/.1	-	-	-	-	-
9	6	"	"	"	"	24.0 - 34.7	Gray limestone with dolomite and chert	-	-	60%, 25-30 ft 9% 30-34.7 ft	-	-	-	8.T.H. 34.7 ft. 8
10	1	"	933 + 36	20 R	778.3	0.0 - 4.6	Water	-	-	-	-	-	-	-
10	2	"	"	"	"	4.6 - 10.0	Gray medium dense fine sand with trace gravel and silt	-	4, 7	-	-	-	-	-
10	3	"	"	"	"	10.0 - 12.5	Gray medium dense sand with some gravel and silt	-	11	-	-	-	-	-
10	4	"	"	"	"	12.5 - 16.0	Brownish lt. gray clay with limestone fragments	-	8	-	-	-	-	-
10	5	"	"	"	"	16.0 - 21.3	Gray hard limestone with dolomite and chert	-	-	89%	-	-	-	-

Appendix D-3 (Cont.)

Boring No.	Sample No.	Highway Route No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size Distribution						Notes	
							Texture	AASHTO		Recovery	RQD	Gravel	Sand	Silt	Clay		LL
11	1	S.R. 46	933+92	23R	782.5	0.0- 3.0	Brown soft sandy clay loam	-	2	-	-	-	-	-	-	-	-
11	2	"	"	"	"	3.0- 5.5	Brown loose sand with silty clay & gravel	-	4	-	-	-	-	-	-	-	-
11	3	"	"	"	"	5.5- 9.0	Gray loose sand with gravel	-	2	-	-	-	-	-	-	-	-
11	4	"	"	"	"	9.0-12.0	Gray medium dense sand with silty clay & gravel	-	8	-	-	-	-	-	-	-	-
11	5	"	"	"	"	12.0-17.0	gray & brown med. dense sand loam with gravel	-	7	-	-	-	-	-	-	-	-
11	6	"	"	"	"	17.0-24.7	gray brown limestone Dolomite & chert	-	-	65%, 19.5-23.1 ft., 70%, 23.1-24.7 ft.	-	-	-	-	-	8.T.H. 24.7 ft	
12	1	"	934+61	23L	788.4	0.0- 9.0	Brown med. stiff silty clay loam w/gravel	-	3,6,5	-	-	-	-	-	-	-	-
12	2	"	"	"	"	9.0-14.5	Brown loose sandy loam	-	3,4	-	-	-	-	-	-	-	-
12	3	"	"	"	"	14.5-24.9	Gray med. dense coarse sand & gravel	-	8,8	-	-	-	-	-	-	-	-
12	4	"	"	"	"	24.9-27.5	Limestone boulders	-	-	0%	-	-	-	-	-	-	-
12	5	"	"	"	"	27.5-37.0	Red stiff clay w/limestone fragments	-	8,8	-	-	-	-	-	-	-	-
12	6	"	"	"	"	37.0-40.2	Brownish gray soft clay w/gravel	-	2	-	-	-	-	-	-	-	-
12	7	"	"	"	"	40.2-50.0	Gray limestone boulders & clay	-	-	54%, 40.5-45.5 ft., 26%, 45.5-50.0 ft.	-	-	-	-	-	-	

Appendix D-3 (cont.)

Boring No.	Sample No.	Highway Route No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Recovery RQD	Grain Size Distribution				Notes
							Texture	AASHTO			Gravel	Sand	Silt	Clay	
12	8	S.R. 46	934 + 61	23 L	788.4	50.0 - 55.2	Reddish brown soft silty clay	-	-	-	-	-	-	-	-
12	9	"	"	"	"	55.2 - 65.0	Gray limestone boulders & reddish brown soft silty clay	-	-	-	-	-	-	-	-
12	10	"	"	"	"	65.0 - 75.5	Lt. gray hard limestone	-	-	60%, 63.5-68.5 ft. 25%, 68.5-70.5 ft. 44%, 70.5-75.5 ft.	-	-	-	-	B.T.H. 75.5 ft.

Appendix D-4 Borehole Data on C.R. 31 over Sand Creek In Decatur County (36).

Boring No.	Sample No.	Highway Route No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Grain Size Distribution							Notes	
							Texture	AASHTO		Recovery	RQD	Gravel	Sand	Silt	Clay	LL		PL
13	1	C.R. 31	21+40	5.5 R	720.3	0.0- 1.0	Asphalt & gravel	-	-	-	-	-	-	-	-	-	-	-
13	2	"	"	"	"	1.0- 3.0	Brown med. dense sandy loam with gravel	-	6	-	-	-	-	-	-	-	-	fill
13	3	"	"	"	"	3.0- 5.0	Brown stiff clay loam	A-7-6(17)	7	-	-	10.5	10.4	49.8	24.3	43	22	21 -
13	4	"	"	"	"	5.0-13.0	Brown med. dense silty loam	A-4(1)	5,8	-	-	0.6	32.1	51.8	15.5	23	19	4 -
13	5	"	"	"	"	13.0-23.0	Brown med. dense sandy loam	A-2-4(0)	5,7	-	-	0.1	79.7	11.1	6.1	NP	NP	NP -
13	6	"	"	"	"	23.0-32.0	Brown med. dense sandy loam	A-2-4(0)	6,5	-	-	7.9	70.0	15.2	6.9	NP	NP	NP -
13	8	"	"	"	"	32.0-37.0	Gray hard lime-stone	-	-	RC-1 95 RQD 49%	-	-	-	-	-	-	-	-
14	1	"	22+11	12 L	692.1	0.0- 7.4	Medium dense sand and gravel	A-1-6(0)	7,8	-	-	44.0	46.1	- 9.9	-	NP	NP	NP -
14	2	"	"	"	"	7.4-12.4	Gray hard lime-stone w/calcareous shale	-	-	RC-1 98 RQD 60%	-	-	-	-	-	-	-	B.T.H. 12.4 ft.
15	1	"	22+92	12 R	694.1	0.0- 5.0	Concrete rubble & weathered rock	-	50/.1	-	-	-	-	-	-	-	-	fill
15	2	"	"	"	"	5.0-10.0	Gray hard lime-stone	-	-	RC-1 90 RQD 8%	-	-	-	-	-	-	-	B.T.H. 10.0 ft.
16	1	"	23+63	12 L	722.8	0.0- 0.5	Brown medium dense sandy loam	-	50/.5	-	-	-	-	-	-	-	-	-
16	2	"	"	"	"	0.5- 2.5	Weathered gray limestone	-	-	0%	-	-	-	-	-	-	-	-
16	3	"	"	"	"	2.5- 7.5	Gray hard lime-stone	-	-	RC-1 100 RQD 81%	-	-	-	-	-	-	-	B.T.H. 7.5 ft.

Appendix D-5 Borehole Data on S.R. 3 over Clifty Creek in Decatur County (37).

Boring No.	Sample Route No.	Station No.	Offset Ft.	Ground Elevation Ft.	Sample Depth Ft.	Soil Description		Blow per Ft.	Recovery	Grain Size Distribution				Notes
						Texture	AAASHTO			RQD	Gravel	Sand	Silt Clay	LL PL PI
17	1	S.R. 3	13+66	39 L	907.0	0.0-2.0 Brown med. atiff sandy clay loam	-	4	-	-	-	-	-	fill
17	2	"	"	"	2.0-6.5	Brown med. atiff sandy clay loam	-	3,1	-	-	-	-	-	-
17	3	"	"	"	6.5-12.5	Gray med. dense sandy loam	-	9	-	-	-	-	-	-
17	4	"	"	"	12.5-22.5	Gray atiff clay	-	9,8	-	-	-	-	-	-
17	5	"	"	"	22.5-27.5	Gray atiff silty clay	-	6	-	-	-	-	-	-
17	6	"	"	"	27.5-29.0	Gray med. atiff clay	-	4	-	-	-	-	-	-
17	7	"	"	"	29.0-34.0	Gray loose sand	-	3	-	-	-	-	-	-
17	8	"	"	"	34.0-38.5	Gray limestone	-	-	26%	-	-	-	-	B.T.H. 38.5 ft.
18	1	"	14+60	33 R	902.0	0.0-5.5 Brown med. atiff clay loam	-	3,3	-	-	-	-	-	-
18	2	"	"	"	5.5-8.0	Brown med. dense sand & gravel	-	7	-	-	-	-	-	-
18	3	"	"	"	8.0-17.5	Gray atiff silty clay loam	-	6,8	-	-	-	-	-	-
18	4	"	"	"	17.5-27.5	Gray atiff sandy clay loam	-	14,10	-	-	-	-	-	-
18	5	"	"	"	27.5-32.5	Gray loose sand & gravel	-	-	-	-	-	-	-	-
10	6	"	"	"	12.5-34.5	Dense sand & gravel	-	50/.3	-	-	-	-	-	-
18	7	"	"	"	34.5-39.6	Massive limestone	-	-	63%	-	-	-	-	-

JHRP-88-9

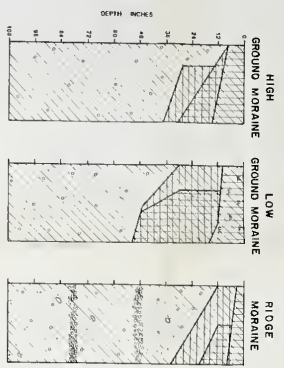
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T.H.P. 88-4

GENERAL SOIL PROFILES

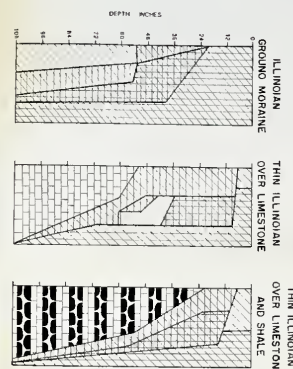
GLACIAL

WISCONSINAN DRIFT

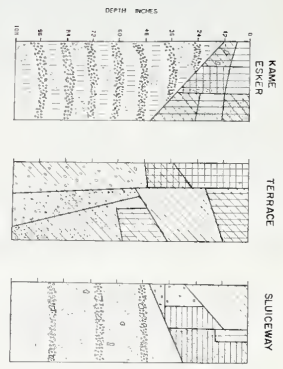


S H E L B Y C O.

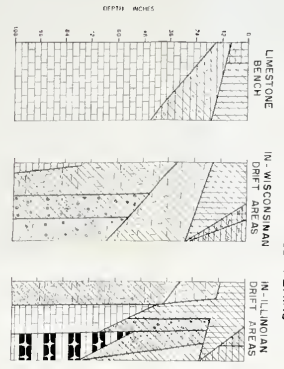
ILLINOIAN DRIFT



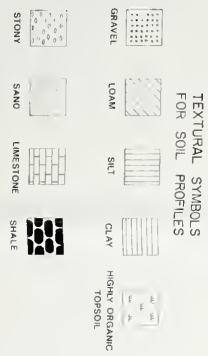
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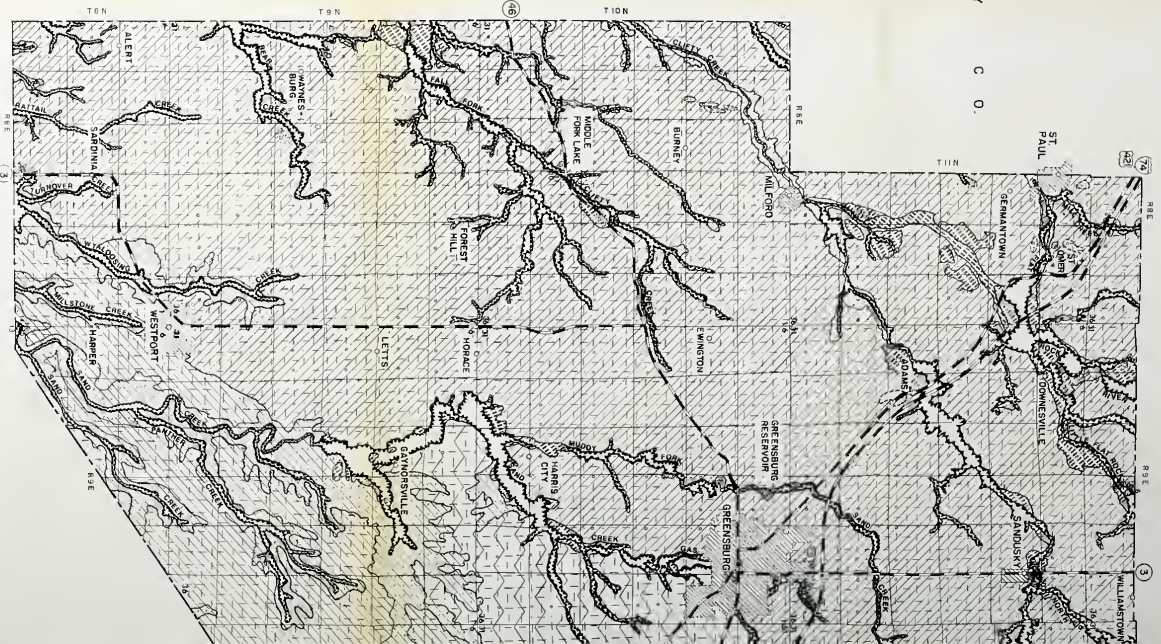
RESIDUAL



FLUVIAL FLOOD PLAINS



B A R T H O L O M E W C O.



J E N N I N G S C O.

ENGINEERING SOILS DECATUR COUN INDIANA

1940 AAA AERIAL PHOTOGRAPHS
PREPARED FROM

JOINT HIGHWAY RESEARCH PROJECT

PURDUE UNIVERSITY
1988

SCALE OF MILES
0 1 2 3 4 5 6 7 8 9 10



ENGINEERING SOILS MAP DECATUR COUNTY INDIANA

PREPARED FROM
1940 AAA AERIAL PHOTOGRAPHS

BY

JOINT HIGHWAY RESEARCH PROJECT

AT

PURDUE UNIVERSITY

1938



LEGEND

PARENT MATERIALS
(GROUPED ACCORDING TO
LAND FORM AND ORIGIN)

- GROUND MORANE, ILLINOIAN
- GROUND MORANE, WISCONSINIAN
- RIOE MORANE
- THIN ILLINOIAN DRIFT OVER
INTERBEDDED LIMESTONE AND SHALE
- THIN ILLINOIAN DRIFT OVER
LIMESTONE
- TERRACE
- SLUEWAY
- KAME AND ESKER
- LIMESTONE BENCH
- FLOOD PLAIN

MISCELLANEOUS

- BORING SITES
- URBAN AREA
- LAKE, POND, OR RESERVOIR
- DAM
- GRAVEL PIT
- QUARRY

TEXTURAL SYMBOLS

SUPERIMPOSED ON PARENT MATERIAL
TO SHOW RELATIVE COMPOSITION

- GRAVEL
- SILT
- SAND
- CLAY

COVER DESIGN BY ALDO GIORGINI